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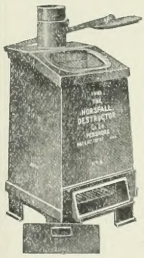

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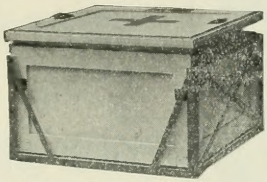

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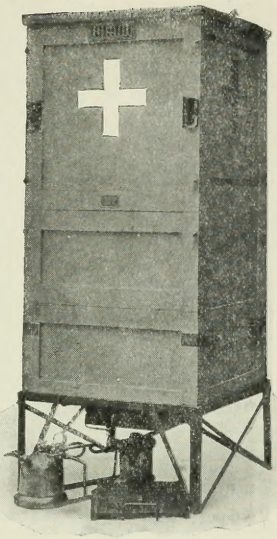

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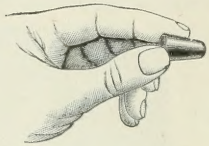

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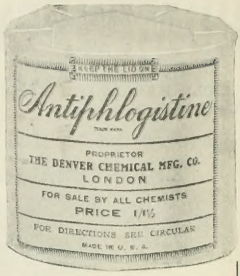

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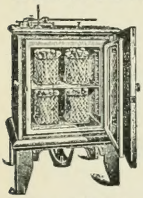

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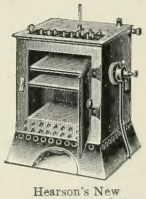

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To face first matt

VOLUME XXVI. AUGUST, 1915. No. 2.

Journal

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Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION IN EGYPT, 1915.

BY TEMPORARY LIEUTENANT-COLONEL ROBERT T. LEIPER, D.Sc., M.B.

Royal Army Medical Corps.

Helminthologist to the London School of Tropical Medicine.

(*Continued from p.* 55.)

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Water in Relation to the Spread of Bilharzia.

With the knowledge that the infective agent of Bilharziosis is the cercaria, and that this can only develop in certain molluscan intermediaries, we have to consider whether anything can be done to control the spread of the disease. Professor Madden, who possesses, perhaps, the most intimate acquaintance of bilharziosis in all its clinical manifestations, wrote in 1910 that "among the Egyptian people generally there exists a widespread endemic disease, responsible for much suffering and a very considerable mortality among the agricultural population particularly, which we, as the controlling powers of the public health of the country, have done nothing to try and prevent." "Only those who are conversant with the habits and ways of the people are capable of judging of the apparent hopelessness of the task; but it is surely time that a beginning should be made with it, though along what lines it is not easy to indicate."

It was hoped by the authorities in Egypt that the preventive measures now being applied to ankylostomiasis would also prove efficacious in dealing with bilharziosis. These comprise free treatment, the introduction of conservancy, and the dissemination of knowledge of the disease amongst the natives. Such measures would appear, however, to be of little value in the control of bilharziosis, for the following reasons:—

(1) In ankylostomiasis treatment not only rapidly cures the individual patient, but by killing the adult parasites also assists in limiting the spread of the disease. In bilharziosis there is no recognized treatment other than merely palliative.

(2) In ankylostomiasis the disease is spread by the fæces only. In bilharziosis both urine and fæces would require control. The introduction of conservancy would not necessarily ensure the immunity of canals and the smaller streams of water from contamination with urine in agricultural districts.

(3) The co-operation of the natives in Egypt could only follow upon years of instruction resulting in a radical change in the habits of the people.

The remedy is to be sought elsewhere. Fortunately, there are certain physical conditions almost peculiar to Egypt which are inimical to the cercaria and its carrier, and which, if properly exploited, might bring about almost complete eradication of the disease in the course of a few years.

Water is absolutely essential for the life of the Bilharzia outside the body. In Egypt all water is derived from the Nile, directly by irrigation canals or indirectly by seepage into wells, and from rain.

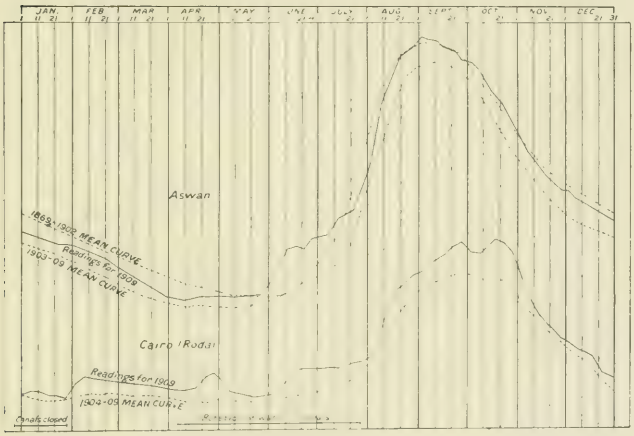

FIG. 23.—Showing annual rise in the Nile during the autumn.

THE NILE: IRRIGATION.

Almost the whole of the water required for the cultivation of the land and for the use of the population is derived from the Nile. Until 1820 the cultivated land was irrigated by the Nile only during its annual rise. The land at the river's edge is ordinarily about nine metres above the river-bed. Every autumn the river rises from seven and a half to ten metres above its bed, as shown in the accompanying diagram (fig. 23). In the early days of Egyptian

history the Nile at these times inundated the whole of the valley. As the population increased, huge dykes were built parallel to the banks of the Nile, and from these other dykes were made stretching from the river to the hills to form large compartments or basins. During the flood the turbid waters of the river were led into these basins by artificial canals, and allowed to saturate the soil thoroughly and to deposit their rich mud on the surface. When each basin was properly irrigated, the water was allowed to pass on into other basins at a lower level, and eventually to return into the Nile when the flood had sufficiently receded to allow this.

According to Willcocks and Craig, this system of "basin" irrigation was in operation over the whole country through the times of the Pharaohs, Ptolemies, and Romans, down to the Arab Conquest in the seventh century. Between 700 A.D. and 1800 A.D. the dykes were uncared for and irrigation was abandoned over the greater part of the delta. The population gradually dwindled from 12,000,000 to 2,000,000. In 1821 Mohamed Ali changed the whole system by excavating a number of deep canals capable of drawing off the waters of the Nile at low level during the summer. This allowed of the cultivation of a summer crop and thus brought about the introduction of cotton upon a large scale. An area of over 3,100,000 acres is now perennially irrigated in Lower Egypt. In 1874, a quarter of a million acres in Upper Egypt and the whole of the Fayum were similarly converted from basin to perennial irrigation. The completion of the Assiut and Assouan barrages have been steps in the conversion of further large areas. At the present day the whole of Lower Egypt under cultivation is irrigated from canals which run throughout the whole year, while in Upper Egypt 964,000 acres are now also perennially irrigated, while 1,287,000 acres still receive their waters in basins through canals running only in flood. During a low flood the amount of water available is not sufficient to keep the whole area under cultivation. Those lands thus thrown out of cultivation are termed "Charaki" and are exempted from taxation (p. 151). With the extension of perennial irrigation the amount of "Charaki" is being continually diminished.

The extension of perennial irrigation has resulted in a marked increase in the prosperity of the people. The population has again risen to over 12 millions. At the same time, perennial irrigation appears to have encouraged the spread of bilharziosis. The disease is much more common at the present day in the Delta and in the Fayum than in those parts of Upper Egypt still supplied only with

Répartition par Moudiriehs des Terres "Charaki," 1899-1912.

Années	Totaux	Assiout	Assouan	Beni Souef	Guerga	Gizeh	Kena	Minia	Behera	Dakahlieh	Gharbieh	Kalioubieh	Menoufieh
1899	352,213	35,075	34,508	10,342	75,813	38,258	135,567	17,492	1,284	204	87	690	2,893
1900	19,038	2,341	2,906	1,957	1,933	4,130	1,171	4,183	117	..	..	..	..
1901	12,845	1,231	1,618	1,455	1,215	1,000	726	2,132	438	..	..	..	..
1902	186,151	11,642	16,629	3,617	18,965	17,718	105,129	11,162	586	..	32	307	364
1903	5,158	611	2,164	426	524	224	322	887	..	..	..	..	..
1904	55,075	4,343	12,940	1,561	1,745	6,118	22,938	5,126	203	..	..	..	101
1905	47,147	4,190	10,397	1,811	2,634	6,177	15,855	5,683	213	..	..	..	187
1906	2,756	5	1,513	..	781	98	113	207	39	..	..	..	..
1907	124,671	6,994	15,947	1,776	16,229	10,185	65,139	8,181	170	..	..	..	50
1908	125	..	..	..	..	125	..	..	..	..	..	..	..
1911	377	11	16	83	..	17	5	235	10	..	..	..	..
1912	25,845	2,873	9,341	643	2,730	744	2,378	6,968	8	9	4	..	144

Ce sont les terres soumises au régime des bassins lesquelles, pendant les années de bas étiage, restent incultes faute d'eau et sont par conséquent exemptées de l'impôt foncier. La superficie de ces terres tend naturellement à diminuer avec l'extension du système de l'irrigation permanente. (From *Annuaire Statistique de l'Egypte*, 1914.)

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basin irrigation. This has been remarked upon by Milton. In the Records of the Egyptian Government School of Medicine for 1904 he states:—

"Cairo is on the dividing line between Upper Egypt and the Delta, and patients come to Kasr-el-Ainy for treatment from all parts of the country; still the disproportion between the number of cases of bilharzia drawn from the two natural divisions of the country is so very marked that there must be some very well defined cause constantly acting, and this, I believe, is to be found in the way in which water is supplied to the different provinces for the purposes of irrigation. The provinces of Lower Egypt are supplied with water for irrigation all the year round, or practically so, whereas the Upper Provinces are supplied with water for irrigation only during and after the time of High Nile. Thus the peasant from Lower Egypt has a much longer period of time during which he is exposed to the chance of infection, and infection is more frequently repeated than is the case with his brother of the Upper Provinces.

"The province of Ghizeh is a case very much in point, for here, although it borders immediately on Cairo, and although Cairo is its hospital town, the proportion of its population per 100,000 coming for treatment for bilharzia is but 9·75 as compared to Sharkieh 19·85, Qalioubieh 18·06, and Menoufieh 13·47, the three other provinces adjoining the capital, but then Ghizeh is basin irrigated, whereas the other provinces named are perennially irrigated."

The relative frequency of bilharziosis in perennially irrigated areas may be due in part to continued liability of the workers to infection as suggested by Milton, but the favourable environment created for the propagation of the intermediate host is probably a much more important factor.

THE NILE: SUBSOIL WATER.

Subsoil water is generally derived from local rainfall, but in Lower Egypt it is practically all the result of seepage from the Nile and its canals. The average thickness of the Nile alluvium is said to be about seven metres, below this is a layer of sand and gravel into which the river-bed dips. Through this layer, when the river is in flood, a natural flow of water takes place and the static head of the river in flood is thus transmitted to great distances, causing a rise in the level of the subsoil water. This rise is sometimes actually visible, for low-lying land near the river may become covered with water. The subsoil water of the deep sand and gravel strata is utilized for the water supply of towns and for purposes

of irrigation in Upper and Middle Egypt and in the southern half of the Delta. In the fields it is not an uncommon sight to see the water being lifted from deep wells by means of Persian wheels or "sakias," as they are termed in Egypt, driven by one or two blindfolded animals: usually buffaloes, but sometimes camels and bullocks (fig. 24). The "sakia" consists of a vertical wheel carrying an endless rope, slung with earthen pots or buckets which dip into

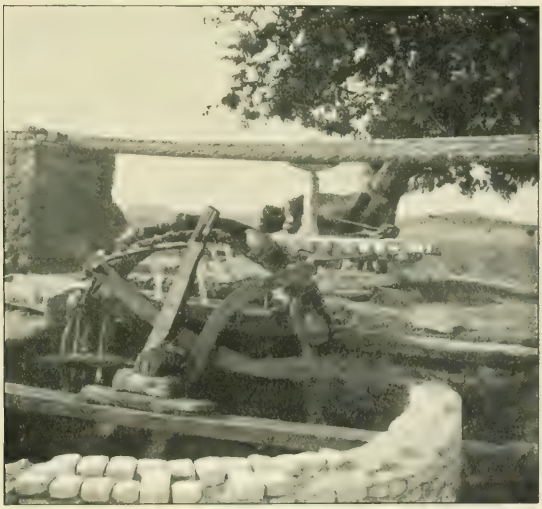

FIG. 21.—A "sakia" in use in the fields near Marg.

the water. On its axle is a rough wooden-cogged wheel actuated by another cog-wheel placed horizontally. This wheel is moved by a pole fixed at one end to the axle and at the other to the neck of the animal being used to turn it.

According to Mr. Crawley there are five thousand two hundred and fifty-five "sakias," and two thousand two hundred and ninety wells with engines and pumps, drawing subsoil water in fields in the Lower Egypt Irrigation Inspectorate.

Rainfall.

The rainfall in Egypt is at no time enough of itself to moisten the soil sufficiently for agricultural use, and is confined to the winter months from October to April. As will be seen from the accompanying table, no rain was recorded from any part of Egypt during the months of June, July, August, and September. Mr. Hurst, of the Physical Science Department of Egypt, has examined the official records for the last twenty years, and has found that an absence of rain during these months has been constant.

Monthly Rainfall in Millimetres during 1912.

Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Alexandria (Mex)	14	26	7	0	0	0	0	0	0	Drops	1	26
Port Said ..	23	58	8	0	6	0	0	0	0	Drops	Drops	9
Suez	Drops	1	0	0	0	0	0	0	0	0	0	4
Ismailia ..	10	6	6	Drops	0	0	0	0	0	Drops	0	6
Cairo, Ezbekia..	3	9	Drops	Drops	0	0	0	0	0	Drops	0	5
Giza ..	4	9	Drops	Drops	0	0	0	0	0	Drops	0	2
Abbassia..	0	7	0	0	0	0	0	0	0	Drops	0	3
Kafr el Zayât ..	9	19	Drops	0	4	0	0	0	0	6	1	9
Tanta ..	10	17	2	0	3	0	0	0	0	1	Drops	10
Kafr el Dawar..	28	58	6	Drops	2	0	0	0	0	1	1	40
Damanhur ..	15	28	7	Drops	3	0	0	0	0	1	Drops	23
Shebim el Kom	2	14	Drops	0	2	0	0	0	0	0	0	4
Damietta ..	67	30	10	Drops	7	0	0	0	0	16	3	17
Manzala ..	13	20	4	Drops	Drops	0	0	0	0	Drops	0	Drops

The average rainfall per annum at Cairo during the last nineteen years is only 3·28 centimetres. Willcocks and Craig estimate that the amount of the Nile water used on the Delta to irrigate the crops corresponds approximately to a rainfall of 1·30 metres, i.e., fifty-one inches per annum.

Protective Measures.

The life of the bilharzia outside the body may be divided into three periods: (1) That between the passage of the egg into water and the entrance of the hatched parasite into the mollusc; (2) the stage of metamorphosis within the mollusc; (3) that prior to the entrance of the free-swimming cercaria into the human body after it has left the mollusc. It is universally recognized that in Egypt under present circumstances it is practically impossible to prevent the contamination of water with infected urine and fæces. In order to break the life-cycle of the bilharzia worm one must find some simple means of destroying it during the free-swimming infective stage, or of depriving it of its essential intermediate host.

The former is the line of attack suited to the conditions under which bilharziosis is acquired in large towns ; the latter is applicable to country villages and districts.

Prevention of Bilharziosis in Towns.

It has been shown earlier in the report that bilharziosis is frequently contracted by young children in the city of Cairo. The infection could have been derived only from the public water supply, and it was suggested that the unfiltered water supplied throughout Cairo by pipes for garden and stable purposes was the most likely source. This water is pumped from the Nile where infections are known to have been contracted. It has been our experience that very few gastropod molluscs could be found on the banks of the Nile in the neighbourhood of Cairo. It is obvious, therefore, that preventive measures applicable to Cairo and similarly situated large towns should be directed to the destruction of the cercaria in the water taken from the Nile. The ideal, of course, would be to do away with the unfiltered supply entirely. It is said, however, that such a course would deprive Cairo of its gardens and would meet with tremendous opposition. As this unfiltered water must be a continual source of grave risk to the public health from other and more virulent diseases than bilharziosis, it is evident that such opposition must have been both strenuous and triumphant when this system of dual supply is still tolerated by the authorities. Numerous experiments were made to determine if infected water could be rapidly sterilized. The results of this inquiry will be detailed later in connection with the supply of safe water to small bodies of men. They were entirely inapplicable to the requirements of Cairo. There is, however, one feature about the bilharzia cercaria which may be used possibly to conserve the unfiltered water supply ; that is the brief duration of life of the free-swimming cercaria. It has been found impossible to keep the cercaria alive for more than thirty-six hours. If it were practicable to store Cairo's daily requirement of unfiltered water for two days or a day and a half, there is no doubt that it would become practically free from danger as far as bilharziosis is concerned. It may be noted, however, that it would at the same time lose that heavy sediment which has a distinct manurial value. Against this loss may be set the fact that, under the present system, one-third of the thirty thousand children born annually in Cairo become infected with bilharzia.

Origin of Bilharzia Infection in Cairo.

The source of infection of the Nile water at Cairo is somewhat difficult to locate. Under the miracidium infection theory it was attributed to contamination of the water by infected urine from the crews on the boats which daily congregate near the Kasr Nil bridge. On the alternative hypothesis of a molluscan intermediary one must look farther afield. The molluscs known to harbour bilharzia cercaria congregate mostly in the smaller canals and ditches where there is a good deal of vegetable substance for food. They are air-breathers and require to seek the surface from time to time. In the Delta, water does not return to the Nile when once it has been used for irrigation purposes. The whole of the agricultural drainage water is discharged either into the salt lakes near the Mediterranean shore or directly into the sea. That of the valley or "Wadi Tumilat" which runs from Zagazig to Ismailia discharges into Lake Timsah on the Suez Canal. In Upper Egypt, however, the canals have escapes at various points on their courses which allow surplus water to return into the Nile. The agricultural drains also discharge into the Nile at certain places. These escapes are indicated on the accompanying map (fig. 25). It will be seen that from Minia to Fashn the drainage is turned sometimes into the Nile, and at other times into the Bahr Yusef, whence it makes its way through the Fayum into Lake Kurun or continues to discharge at El Ayat by the Giza Canal escape. Between Fashn and El Ayat all drains escape into the Nile, while below El Ayat the drains discharge into the large Moheit drain which enters the Rayah el Behera below the Barrage north of Cairo. A few miles south of Cairo it will be noticed that the Giza Canal has two escapes into the Nile.

Effect of Varying Velocities of the Nile.

The velocity of the Nile varies from month to month. Whereas the movement of water down the Nile from the Assiut Barrage to the Delta Barrage occupies seven days in a mean year during March to August, in September the water travels the same distance in three days, in October and November it takes four days, while from December to February five days are necessary. Taking one and a half days as the approximate duration of life of the free-swimming cercaria, it is evident that at all times of the year water freshly contaminated with cercaria at Assiut would become safe long before it reached Cairo. During high flood in September the Nile has a velocity of about one hundred and fifty kilometres per diem, that is water containing freshly discharged cercaria entering the Nile within about one hundred and fifty miles up-stream of Cairo would

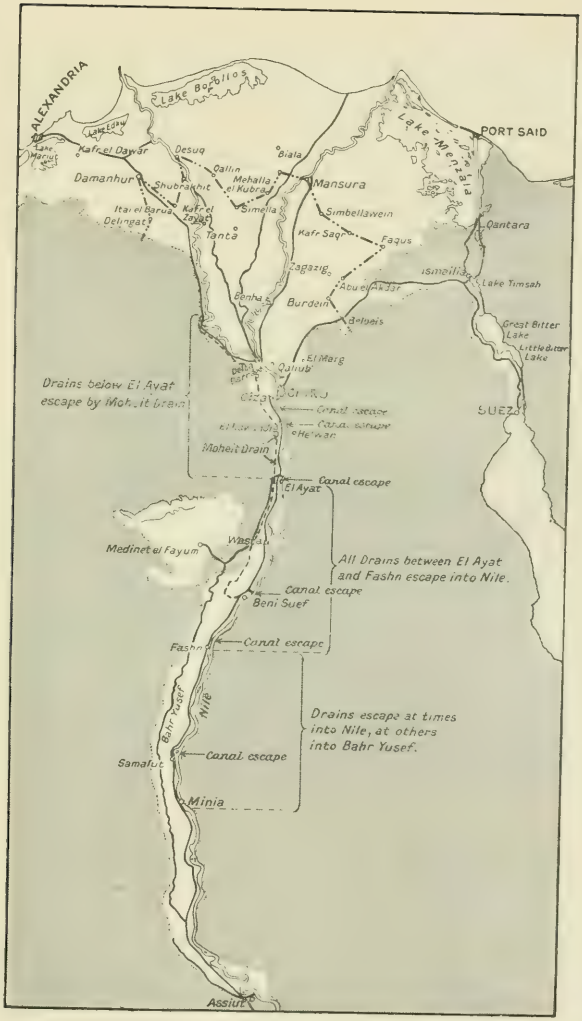
ALEXANDRIA
Lake Mareotis
Lake Edku
Lake Boccalos
Kafr el Dawar
Desuq
Damanhur
Shubrakhit
Itai el Barud
Delingat
Kafr el Zayat
Tanta
Simella
Galin
Mehalla el Kubra
Biala
Mansura
Simbellawein
Kafr Saqr
Faqus
Zagazig
Abu el Akhdar
Benha
Burdein
Abuais
Lake Menzaleh
PORT SAID
Qantara
Ismailia
Lake Timsah
Great Bitter Lake
Little Bitter Lake
SUEZ
El Marg
Qalyub
Cairo
Canal escape
Drains below El Ayat escape by Mohit drain
Mohit Drain
El Ayat
Canal escape
Medinet el Fayum
Wasta
All Drains between El Ayat and Fashn escape into Nile.
Canal escape
Beni Suef
Fashn
Canal escape
Nile
Bahr Yusef
Drains escape at times into Nile, at others into Bahr Yusef.
Samalut
Canal escape
Minia
Assiut

FIG. 25.

still be infective when passing the city. Minia is a little more than this distance from Cairo, so that all the drainage water which, as we have seen, discharges into the Nile between Minia and El Ayat would still be infective at Cairo during the time of high Nile. During the summer months when the Nile is at low stage the maximum velocity at Wasta (see fig. 25) varies between thirty and thirty-three kilometres per diem, according to Craig. Farther down stream this will be less as the Delta Barrage is reached, owing to decrease of slope. About thirty kilometres per day would be a fair average over this reach. According to this, active cercaria would only travel thirty miles in a day and a half, so that infected water entering the Nile more than thirty miles up-stream, i.e., above El Ayat, should have become innocuous by the time it reached Cairo except in so far as occasional infected molluscs may be carried down by the current.

If the facts upon which these conclusions are based are approximately correct, the Nile at Cairo, and therefore the unfiltered water supply, should be infective chiefly during the autumn; the source of infection during the rest of the year being apparently limited to the escapes between El Ayat and Cairo.

Velocities of the Canals in the Delta.

Down stream from Cairo, water only re-enters the Nile and the main canals by seepage. From September to December water takes 1·6 to 1·9 days to travel from the Delta Barrage to the sea. From January to April the period gradually lessens from 2·1 to 2·6 days; in May, June and July 2·8 days are occupied. From this we conclude that even during Nile flood the branches of the Nile and the main canals in the northern half of the Delta are less liable than the Nile above Cairo to be infective. The bulk of infections in the Delta must therefore originate directly from the small tertiary canals, the agricultural drains and the large drains which carry the discharge from these to the sea.

Infection in the Maritime Canal Zone.

This brings us to a consideration of the Ismailia or sweet water canal carrying fresh water from the Nile north of Cairo to Ismailia, Suez and Port Said.

The Sweet Water Canal.

The Ismailia Canal from Cairo to Ismailia is 128 kilometres, i.e., 80 miles. From Ismailia to Suez 90 kilometres, i.e., 56 miles, from Ismailia to Qantara it is approximately 34 kilometres, and thence to Port Said about 43 kilometres The maximum velocity on the Ismailia Canal is near

the head, about 42 kilometres per day, which probably falls somewhat lower down. On the Suez portion of the fresh-water canal at 40 kilometres from Ismailia, the velocity, according to Mr. Hall, is 0·27 metre per second—i.e., less than 24 kilometres, or 15 miles, per twenty-four hours.

Mr. Craig, of the Statistical Department, writes, that the time of flow from the Barrage to Ismailia may be taken as two days, and that this rate does not vary much from low stage to high stage

Fig. 26.—The Port Said branch of the sweet water canal at Qantara.

of the river. From this one may conclude: (*a*) that any infection entering the canal at its head, even during high flood, would have died out before it reached Ismailia; (*b*) any bilharzia infections acquired in the Canal zone from the Port Said and Suez branches of the canal must originate from local infection of molluscs in the Ismailia Canal. In the stretch from Cairo to Ismailia the canal is very free from vegetation, and molluscs are relatively very rare. From Ismailia to Qantara, and from Ismailia to Suez, the amount of weed is so great that it is difficult to traverse these sections

by motor launch. Among the weed, specimens of Bullinus are common. We did not succeed in finding infected forms. These two canal branches are the sole sources of supply of fresh water to Port Said and Suez. They are open to contamination with bilharzia: (1) from villages upon the banks; (2) from the pathways running the whole course of the canal; and (3) from shipping. The water appears to be infective only to a relatively small degree, because the children in the schools of Suez and Port Said show a

FIG. 27.—The sweet water canal outside Ismailia.

low percentage of cases. At Suez, one child out of nineteen in a school on the outskirts of the town was infected. At Port Said, according to Dr. Orme, bilharzia eggs were found in the urine of five out of forty healthy pupils in the Government school. At Ismailia, unfiltered water taken from the canal on the outskirts of the town is supplied to the European houses and is actually laid on as the cold water supply in the bathrooms. Had the canal water been commonly infected a considerable number of cases of bilharziosis should have been recorded among the European inhabitants.

The Port Said section of the fresh-water canal is not being used by boats and is only open to infection at the present time from those using the footpath along its bank. If this path were diverted the risk of infection should become negligible after some months. On the southern section from Ismailia to Suez a number of villages have arisen on both banks. Paths follow both banks. The canal is used regularly by small boats making forty to one hundred

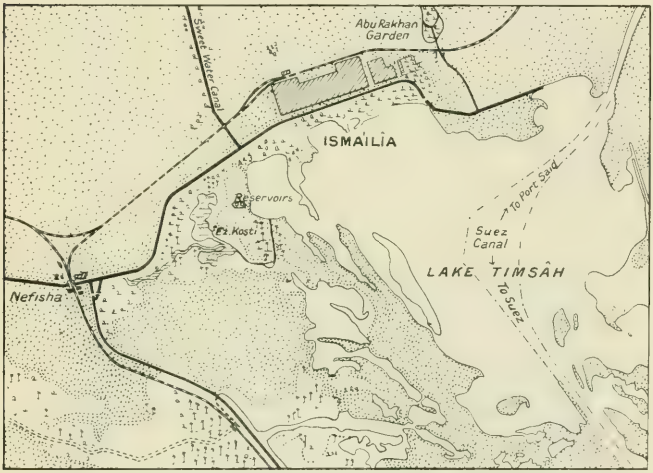

Fig. 28.—The relations of the Sweet Water Canal and its branches to the town of Ismailia.

journeys per month in each direction. From this canal water is led at intervals by small channels to the posts on the maritime canal. It appears impossible to insure under present circumstances that the water reaching these posts should be free from infection.

Marshes.

Local practitioners state that there is a fair amount of bilharzia amongst the native population of Ismailia. This is most probably acquired in the low-lying fields and marshes to the south-west of the town, and from the Taftish el Wady drain, which carries off the whole of the drainage of the Wady Tumilat, between Tel el Kebir and Ismailia, and ultimately debouches into Lake Timsah. Specimens

of *Planorbis boissyi* were common in the marshes and ditches there and were found harbouring developmental stages of bilharzia type.

Marshes, which usually occupy low-lying areas and derive their water in part from seepage, can only be dealt with adequately by filling. The value of the land reclaimed should compensate for this necessary outlay. Moreover, these marshes are the main breeding-places of malaria-bearing mosquitoes, and on this account

Fig. 29.—Filling marsh at Ismailia.

alone their abolition is called for even at some cost to the State, as shown in the accompanying photograph (fig. 29). The marshes near Ismailia which were found to be a possible source of danger on account of bilharziosis are being rapidly filled in as an anti-malaria measure in completion of Sir Ronald Ross' recommendations for the protection of Ismailia.

Prevention of Bilharziosis in Agricultural Districts.

Whereas the essential condition to the prevention of bilharziosis in towns was found to be the destruction of the free-swimming

(From "A Textbook of Egyptian Agriculture.")

FIG. 30.—The wooden trough, "badala" or "waboor," for lifting water from twenty-five to fifty centimetres, in use.

(From "A Textbook of Egyptian Agriculture.")

FIG. 31.—The "nattala," a closely plaited straw basket with four cords, for lifting water about one metre.

cercaria, in country districts water in small canals, shallow ditches and irrigated fields is so general and there are certain agricultural appliances (such as those illustrated in fig. 30 and fig. 31) which necessitate continual exposure to infected water in such common use that other preventive measures must be found.

Fig. 32.—Iron pipe in the course of the Marg Canal regulating amount of flow.

Government Control of Nile Water.

In those areas enjoying the privileges of perennial irrigation the water is not allowed to run indiscriminately. The supply is carefully husbanded and is entirely under the control and constant supervision of the Irrigation Department. The irrigation outlets from the public canals are furnished with iron pipes of a definite diameter so that the amount of water passing shall bear a calculated relation to the area served (fig. 32).

During the summer months the water in the canals is controlled by the periodical closure of the head regulators for definite periods. These times are officially announced by the Government. A copy

of the announcement for the earlier part of the summer of 1915 is reproduced on the page opposite. It will be seen that after running for a period of six days the water was shut off for fifteen days. This system of "rotation" was enforced at the beginning of April and was maintained until the Nile flood (as shown in fig. 23) reached the Delta early in August.

Under the Canal Act of 1894 severe penalties are imposed upon those attempting to interfere in any way with the working of the irrigation system. Imprisonment for periods up to two months and fines not exceeding £20 may be imposed in cases of infraction or disregard of the law.

With the increase in the amount of water available which has followed upon the building of the various dams and reservoirs, new lands more remote from the Nile have annually been brought under cultivation.

Suggestions for Eradication.

If some simple means could be found of stamping out the molluscs in those situations in which the molluscs harbouring bilharzia congregate and multiply not only would the incidence of the disease be greatly reduced in the country, but the liability to infection would also be greatly diminished in the large towns, e.g., Bilbeis, on the main drains into which the small drainage ditches discharge. The following proposals are based upon a study of the problem in the district of which Marg is the centre. The method, which seems applicable to other parts of Lower Egypt, save, perhaps, those in which rice is the chief crop during the summer months, utilizes the present "rotations" in the supply of water enforced by the Government from April until August. During periodical stoppages of fifteen days the El Marg Canal became dry except for occasional puddles (figs. 11, 12, 33, 34, 35). The molluscs were either stranded upon the drying mud or collected in these puddles. It was found that several days before the return of the water the Planorbis and Bullinus taken from the dry bottom did not revive when placed in water. Those in the small puddles of water had been able to survive, the Planorbis being apparently more hardy than the Bullinus. Had any attention been given to the alignment of the Marg Canal so that small collections of residual water could not provide a "carry-over" for the molluscs, these would have been killed automatically by the "rotation" alone, just at the commencement of their annual reproductive activity. The same

Drying.

[*Copy.*]

MINISTRY OF PUBLIC WORKS.

IRRIGATION DEPARTMENT—FIRST CIRCLE.

PROGRAMME OF SUMMER ROTATIONS, 1915, IN QALIUBIA, SHARQIA, AND DAQAHLIA PROVINCES.

Canals on Cotton Rotations.

The following are the sections into which the various canals are divided for rotation purposes : –

Names of Canals	Limits of Sections					
	Section A		Section B		Section C	
	From	To	From	To	From	To
Isma'ilia branches	Head	Qalubia boundary	—	—	—	—
Sharqawia	Head	Khalili Head	—	—	—	—
Sissa	,,	Tail	—	—	—	—
Matsafawia	,,	,,	—	—	—	—
Qenneba and branches	,,	,,	—	—	—	—
Khalili and branches..	—	—	Head	Tail	—	—
Zefeita and branches..	—	—	—	—	Head	Tail
Shebini and branches	—	—	—	—	,,	,,

SUMMER ROTATIONS (1915) IN LOWER EGYPT.

Summer Rotations, in accordance with the lists already published for each Circle of Irrigation, will be imposed throughout Lower Egypt as per the time-tables given below :—

Canals on Cotton Rotations.

	Period		Sections		
	From	To	*A*	*B*	*C*
	April 8	April 13	Stopping	Working	Stopping
	,, 14	,, 19	Stopping	Stopping	Working
		April 20		General stopping	
21 days	April 21	April 26	Working	Stopping	Stopping
		April 27		General stopping	
	April 28	May 3	Stopping	Working	Stopping
		May 4		General stopping	
	May 5	May 10	Stopping	Stopping	Working
		May 11		General stopping	
	May 12	May 17	Working	Stopping	Stopping
21 days		May 18		General stopping	
	May 19	May 24	Stopping	Working	Stopping
		May 25		General stopping	
	May 26	May 31	Stopping	Stopping	Working

REMARKS.

(1) *Sub* channels not specifically named in this list will be on the same rotation as the parent channel from which they derive their supply.

(2) The working turn, or period over which irrigation is allowed, begins at sunrise of the first day of the period and ends at sunrise of the day following the last day of the period.

(3) During the working turn of any section, water will be supplied, to the extent that the available supply of water may permit, to all public and private canals and outlets lying within the limits of that section, as described in the programme.

(4) The heads of all private canals and all outlets must be punctually closed and all lifting machines must cease to work at the expiration of the working turn.

(5) By Article 32 (30) of the Canal Act, 1894, it is enacted :—

"Whoever takes water from a canal, whether by opening the head of the canal, or of the water-course, or by cutting banks, or by lifting the water artificially during the days that the Inspector of Irrigation or any other authority duly authorized shall have made known that water from the canal must not be used for irrigation, will be punished by imprisonment for a period of from fifteen days to two months, and a fine not exceeding L.E.20.

(6) The prescriptions of Article 32 (30) of the Canal Act will be strictly enforced, and the Irrigation Service will take such further administrative measures in case of infraction or disregard of the Law as the nature of the case may require.

(7) The breakdown of a lifting machine gives no right to compensation-supply out of turn.

object might be attained by the provision of an alternative route for the "rotation" water from the secondary canal to the fields.

Chemical Agents.

The small collections of residual water might be treated chemically so as to destroy the surviving molluscs. As the water so treated would be carried on to the land at the commencement of the following "rotation" it would be essential that the chemical used should not be injurious

Fig. 33.—The bed of the Marg Canal in the village during a summer rotation.

to the crops. Certain chemicals are used nowadays on a large scale as manures. It was found experimentally that some of these, especially ammonium sulphate, in weak solution killed the molluscs within a few hours. This chemical manure can therefore be used with safety, and *without ultimate loss*, to kill off those molluscs which had escaped destruction by drying.

Closed Drains.

The small drains, such as that figured on page 39, are less cared for, as a rule, than the small supply canals. They consequently become over-grown

with weeds, which frequently afford sufficient protection to the molluscs to enable them to survive for a considerable period. In Egypt, drainage is always effected by means of open drains. The periodical clearing of these drains must, therefore, be regarded as an essential part of any scheme for the eradication of bilharziosis until the open drain can be abolished.

The English system of field drainage by underground pipes has scarcely received proper trial in Egypt. Quite recently the State Domains Administration made some experiments on the washing of salted land by filtration into drain pipes and this method was found to be better than that of filtration into open drains. The cost, however, proved out of proportion to the extra benefit from the agriculturists' point of view.

Although the initial cost may seem considerable, it should not be overlooked that there would be a distinct saving in other directions. The annual charges for clearing the open drains would be abolished, there would be no heavy losses or damage through the falling of live stock into the drains, and the land recovered would represent a considerable increment of capital.

Lang-Anderson has estimated that if pipes could be obtained in Egypt at about the same cost as prevails in England, the conversion of an open drain 300 metres in length into a covered drain would involve an outlay of a little over £3. About 1,200 square metres of land previously occupied by the open drain would then be available for agricultural purposes. Valued at £42 per feddan, this recovered land would be worth £12.

The mole drain plough is said to be an efficient and very cheap method of drainage. Lang-Anderson believes that the soil of Egypt would give a satisfactory bore to this machine. If this proved to be the case earthenware pipes could be dispensed with.

Canal Clearances.

The canals are closed annually for a period of a month, usually from December 25 to January 25, to allow of the removal of silt. If it were practicable to carry out these canal clearances at the commencement of the summer in conjunction with the rotations of water, the work should greatly assist in the elimination of the fresh-water molluscs.

A Summer Campaign.

As the anti-bilharziosis measures proposed depend for their success upon the summer rotations, the campaign would be confined to the months from April to August. We now proceed to acquaint ourselves with the agricultural activities in perennially irrigated land during these months, to see to what extent these would assist or

FIG. 34 Marg Canal as it enters the village, a few days after the water has been cut off in the "rotations."

FIG. 35.—Marg Canal passing the railway station, same view as in fig. 5, but during the "rotations."

interfere with the steps proposed. The main crops in Egypt are cotton, wheat, clover, and maize. Wheat and clover are winter and spring crops, and are harvested by May. Cotton occupies the land from April until October. Maize is a "catch" crop, sown late in July and harvested in October. Apparently the chief crop under cultivation during June and July is cotton. Cotton is not grown annually. On the best land it can be grown every alternate summer, but it is usually planted once in three years on the same land.

Dates of Sowing and Harvesting in Lower Egypt.

Sowing.		*Harvesting.*	
March to April	Cotton.	March to April	Flax.
	Lucerne.		
	Earthnuts.	April	Fenugreek and lupins.
	Henna.		
	Onions.		
	Summer melons.		
	Sugar-cane.	April to May	Barley.
May to June	Summer rice.	May	Wheat.
		June	Seed berseem.
June to July	Sesame.	July	Onions.
July to August	Flood melons.	July to August	Summer melons.
	Maize.		
	Millet.		
	Flood rice.		
Sept. to Nov.	Berseem (clover).	Sept. to Nov.	Summer rice.
			Dates—cotton.
		Sept. to Dec.	Henna.
Oct. to Nov.	Lupins.	Oct. to Nov.	Maize.
	Flax.		Sesame.
			Melons.
Nov. to Dec.	Wheat.	Nov. to Dec.	Maize.
	Barley.		Millet.
	Beans.		Earthnuts.
		Nov. to March	Sugar-cane.
		Nov. to May	Green berseem.

On the simple three years' rotation usual in Egypt the land is divided into three parts, and placed under wheat, clover, and cotton. Wheat and clover being winter crops are harvested before June, and the land is left in bare fallow until the following February, unless a catch crop of maize is interposed at the beginning of August. We see from this that at the present time two-thirds of the land is annually in bare fallow during June and July, while the remaining third is under cotton.

Turning now to fig. 36, it will be observed that May, June and July are the months in which humidity reaches its lowest point, and the temperature attains its maximum, consequently evaporation is most rapid at this time. The climatic and agricultural conditions in Egypt are therefore most favourable for a campaign against the

Average	First Year		Second Year		Third Year	
	Winter	Summer	Winter	Summer	Winter	Summer
One-third	Wheat	Bare fallow or Maize ("Catch" crop)	Clover ("Catch" crop)	Cotton	Clover	Bare fallow or Maize ("Catch" crop)
One-third	Clover		Wheat	Bare fallow	Clover ("Catch" crop)	Cotton
One-third	Clover ("Catch" crop)	Cotton	Clover	or Maize ("Catch" crop)	Wheat	Bare fallow or Maize ("Catch" crop)

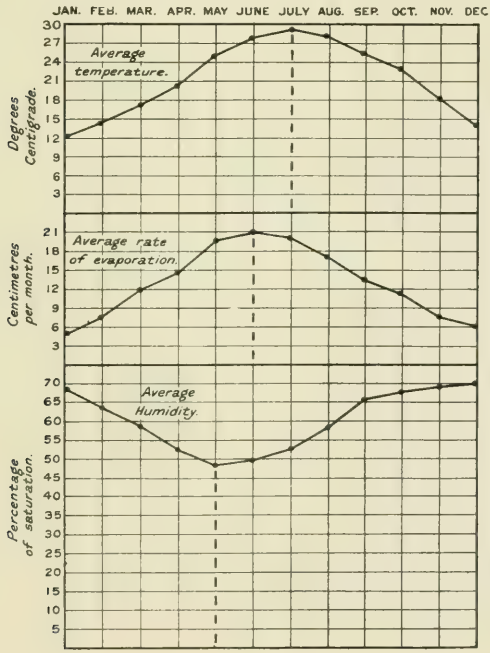
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.
Average temperature.
Degrees Centigrade.
30 27 24 21 18 15 12 9 6 3
Average rate of evaporation.
Centimetres per month.
21 18 15 12 9 6 3
Average Humidity.
Percentage of saturation.
70 65 60 55 50 45 40 35 30 25 20 15 10 5

FIG. 36.—Monthly average temperature, humidity and evaporation.

molluscan carriers of Bilharzia during June and July. Taking tertiary canals as supply units, it should be possible by adjusting the rotation of crops so to group the land under cotton that, in a given area, a third only of the tertiary canals need be used during these months. The tertiary canals and drains supplying the other two-thirds of the land would become thoroughly desiccated, and their molluscan fauna completely destroyed.

If the additional precaution of screening the tertiary canal head were taken, the diminished supply involved by the mesh should be compensated for by the insertion of a second screened pipe rather than by the replacement of the original pipe by one of larger bore. The screens would require periodical cleaning and supervision throughout the year.

Utilizing Lean Years.

The table of charaki lands given on p. 151 shows in feddans that a large area, varying from year to year, is thrown out of cultivation when there is a shortage of Nile water during the summer. Further, the Government, under circumstances like those operating during the present War, takes steps to restrict the area placed under cotton. Whenever the land is brought into bare fallow from such causes, efforts should be made as far as possible so to group the incidence of fallow and cotton fields in a given area that the transient financial loss directly contributes to a diminution in the amount of Bilharziosis in the district penalized.

Bilharziosis Campaign and Cotton Worm.

The proposal to render cultivated land as dry and hot as possible during the whole of June and July as a means of attacking the bilharzia-carrying molluscs would be very beneficial for the cotton fields themselves. The prominence of Egyptian cotton in the world's market is based upon its quality alone, and it has been shown that considerable deterioration follows a too copious supply of water. Moreover, when green and well-irrigated fields of clover are interspersed between the cotton fields during June, the cotton worms are provided with plenty of food and shade until the young cotton plants have produced sufficient foliage to receive them. If, on the other hand, the cotton fields can be kept dry, and the plants consequently hard and fibrous, millions of the cotton worms would perish.

Roads and Shipping.

The contamination of the water with infected urine and fæces must continue so long as the river and main canals are the chief vehicle for transport in Egypt. There are still few main roads, and these generally

occupy the banks of canals and main drains which are entirely open to pollution. At the present day, as in the time of Herodotus, "The Egyptians perform publicly those natural functions which it is the custom for members of other races to carry out in private." In the new areas now being reclaimed, it should be possible to provide more adequate protection for the main watercourses.

The replacement of the small agricultural drains by piping or by "mole" drains, together with the proper utilization of canal clearances and the periodical drying of the small canals during the summer "rotations," should prove successful in controlling bilharzia, even although the molluscan intermediaries were not entirely destroyed. The molluscs are slow in growth and propagation as compared with other animal carriers of human diseases. Re-stocking with half-grown or adult forms might be prevented if it proved practicable to screen the iron pipe regulating the flow of a tertiary canal at its head.

Concerning Reclamation.

At the beginning of the nineteenth century, owing to neglect, the cultivated area of the Delta had shrunk to that portion lying between Cairo and an irregular line (shown on fig. 25) passing through Delingat, Damanhur, Itai el Barua, Shubrakhit, Desuq, Qallin, Simella, Mansura, Faqus, Burdein, and Bilbeis. The introduction of perennial irrigation brought about a rapid increase in the population of Egypt, which was met by an extension of the area brought under irrigation. This increase still continues and is greatest where irrigation projects are most active. During the ten years ending 1907 the population, according to Willcocks, had increased sixteen per cent, while the cultivated area increased only thirteen per cent. It is clear, therefore, that new land must be brought continually under cultivation to meet the increasing needs. The total acreage of Lower Egypt is 5,190,000 acres. Of this, 3,100,000 acres are now cultivated land, 1,190,000 acres are waste land ("Berea"), or ordinarily too salted to produce crops without reclamation; 600,000 acres are covered by lakes. The whole of the Berea or waste land was cultivated in the Ptolemaic and Roman era. According to local tradition some of these waste tracts now bordering the lakes were once covered with vineyards or divided into enormous basins planted with wheat. The numberless mounds strewn with bricks and pottery which nowadays arise from these extensive barren plains are evidence that they once supported a dense population.

As we have seen (p. 150) the extension of perennial irrigation in the past has been accompanied by a similar extension of bilharzia infection. The bilharzia-carrying fresh-water molluscs cannot live in saltish water. Every effort should be made, therefore, in the future reclamation of the salted lands in the north of the Delta to ensure, as far as possible, that favourable conditions are not created at the same time for their colonization by the bilharzia-spreading molluscs.

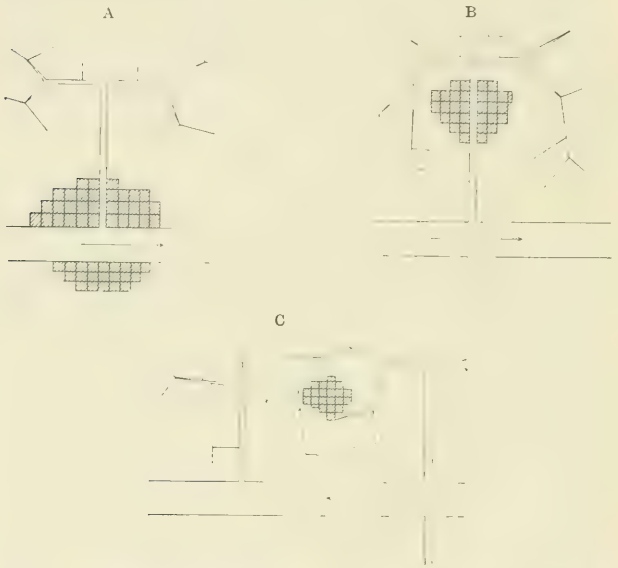

FIG. 37.—The relations of villages to the canals. A, village on either bank of a main or secondary canal: B, village on a tertiary canal; C, village between two tertiary canals.

(1) If the banks of main canals or drains are used as roads the water should be adequately protected from contamination. If possible, however, the roads should run between the terminations of two systems of tertiary drains.

(2) Villages should not be made on the main drains or on the primary or secondary canals. They should be located as far as

possible between two tertiary canals. A glance at fig. 37, A shows at once that where a village is on the bank of a main or secondary canal the bilharzia eggs and embryos carried on in the main stream passing through the village are liable to infect all the tertiary canals supplied from the canal in the section down stream of the village. This arrangement one sees frequently on the Suez section of the sweet water canal. Where the village is on a tertiary canal (fig. 37, B) as happens at El Marg, the water passing through the village is dissipated on the surrounding fields so that the area of infectivity of the village is limited practically by its own communal boundaries. Where a village lies between two tertiary canals, as in fig. 37, C, the liability to contamination of the water channels is practically restricted to those paths leading from the village and such branches as are used for washing and other domestic purposes.

(3) The village water supply should be derived from "sakias" or deeper wells. Each irrigation unit should possess paired supply canals and drains, so that these may be alternately dried without interfering with the irrigation. At Marg, when the canals became practically dry during the rotations, a certain amount of water was drawn from a sakia in the middle of the village. On one occasion when the shortage was becoming serious, a neighbouring land proprietor diverted a generous supply of clear artesian water into the Marg Canal. This, however, revived enormous numbers of molluscs which otherwise would, undoubtedly, have been killed by drying before the completion of the rotation cycle!

(4) Surface-water drains should be reduced, as far as possible, by the utilization of infiltration drains.

The Mosséri system of field drainage, which is said to be simple, economical, and extraordinarily effective, seems, of the various systems of land reclamation at present in use, to be the one most likely to produce those conditions that are unfavourable to the spread of bilharziosis.

Its dual system of "collecting" drains affords more complete control. From the section shown in fig. 39, it will be apparent that the bulk of the surface water, after irrigating the land, rapidly drains by a separate surface drain into the main drain, while the water which has soaked into the soil is drawn off by a deep infiltration drain to be pumped later into the main drain. The surface water drain can therefore be readily sterilized during the summer by drying, while if need be, the deep infiltration drain can be treated with chemical agents, or periodically cleared.

ADMINISTRATIVE.

If a campaign against bilharziosis were commenced on the lines here proposed it is evident that the whole scheme should be under the charge of a medical zoologist, who should be attached, not solely to the Public

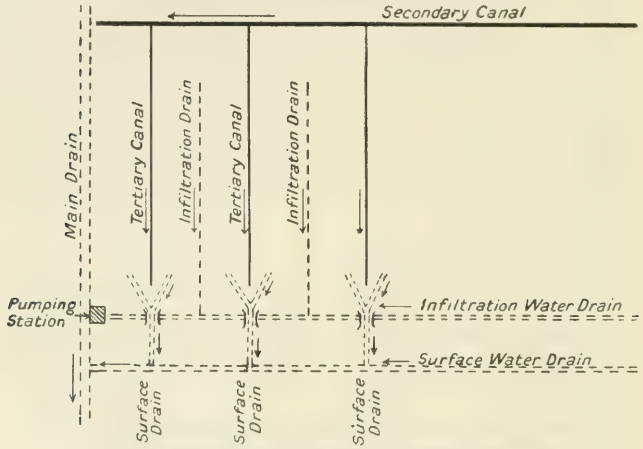

FIG. 38.—The Mosséri system of drainage. (After Willcocks and Craig.)

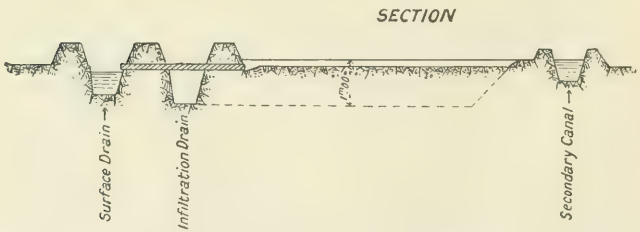

FIG. 39.—Section showing relation of infiltration and surface drainage in the Mosséri system. (After Willcocks and Craig.)

Health Service as in an ankylostomiasis campaign, but also to the Department of Irrigation. In this way only could the full and continuous effect of the present administrative control of the Nile

water be brought to bear upon the bilharzia-carrying molluscs so as to ensure their permanent eradication from lands now heavily infected and their exclusion from new areas about to be reclaimed.

Protection of Troops and Personal Prophylaxis.

Having dealt with the mode of transmission and suggested the lines upon which eradication might be effected in the course of a few years if undertaken by the State, we come now to consider the preventive measures that should be adopted by the individual, or collections of individuals, working in districts where the disease is still rife. It is obvious from what has been said on p. 47 (Part I), that in large towns where filtered water is supplied both for drinking and bathing there is practically no risk to the European. A study of the bionomics of the cercaria gives the data wherewith unfiltered water can be rendered safe where filtered water is unavailable or insufficient for all personal purposes.

Bionomics of Bilharzia Cercariæ.

Activity. The bilharzia cercariæ move by louping and by swimming. They crawl rapidly over any surface by alternate use of the oral and ventral suckers, the tail being dragged behind passively. When swimming the tail and the whole body gyrates and the cercaria progresses with the pronged tail foremost. Swimming is not continuous. Brief periods of activity are regularly alternated with periods of rest. During these latter the cercaria very slowly sinks. When seen with a hand lens their attitudes recall slightly minute mosquito larvæ. As a rule they frequent the surface, but when a small mammal like a mouse is placed in the water they at once attack the skin. As successful infection resulted in a young mouse after only ten minutes' immersion on a single occasion they appear to be able to pierce the skin very rapidly.

Duration of Life. In ordinary tap-water freshly discharged cercariæ usually live about twenty-four hours. A considerable number survive thirty-six hours, but none has ever been found alive after forty-eight hours. They are apparently unable to obtain nourishment from water. An infected mollusc will apparently continue to discharge active cercariæ for a long period. On two occasions infected *Planorbis boissyi* were kept in tap-water, which was renewed daily for three weeks. Large numbers of cercariæ were discharged into the water every day.

Effect of Drying.

The cercariæ can survive on a damp surface from which the visible water has disappeared. They are immediately killed if the drying process is allowed to proceed to the extent of abstracting fluid from their bodies. They cannot withstand the slightest desiccation.

Need of Oxygen.

Although the bilharzia cercariæ, with one exception, are not provided with eye-spots, the bulk are found near the surface of the water. They accumulate there irrespective of exposure to light. If a thin layer of oil or refined paraffin is poured on to the surface of the water the length of life of the cercariæ is reduced to a few hours. This may also be observed when a drop of water containing cercariæ is periodically examined under a sealed cover-glass. If a bubble of air has been left in the preparation it will be noticed that the cercariæ course round and round its circumference like moths around a flame.

The obvious purpose is to obtain oxygen from those portions of the water nearest the air.

Effect of Temperature.

The free-swimming bilharzia cercariæ can survive a temperature of 45° C. They are killed, however, when the temperature is momentarily raised to 50° C. This corresponds very closely to the clinical finds of Conor [116] in Tunis. He noted that bilharziosis is acquired from the waters of the thermal springs at Gafsa, Tozeur and Gabès, which have a temperature of from 28° C. to 45° C., while the disease was quite absent in the neighbourhood of other springs in Tunis where the temperature ranges from 50° C. to 70° C.

Effect of Chemical Reagents.

Very weak alkalies were found to have a stimulant action and weak acids an inhibitory effect on the movements of the bilharzia cercariæ. One in five hundred hydrochloric acid kills immediately. The following acids, acid salts, essential oils and antiseptics were found in dilute solutions of varying strengths to have a lethal effect on the cercariæ:—

Salicylic acid	1 in 1,000	Kills at once.
	1 in 2,000	Slight movement after 50 minutes.
Benzoic acid	1 in 2,000	Kills at once.
Sodium bi-sulphate	1 in 1,000	Kills almost immediately.
Oil of cloves	1 in 1,000	Kills in 10 minutes.
Creosote	1 in 1,000	Immediate paralysis; slight movement of tail.
Felix mas	1 in 5,000	Kills in 15 minutes.
Chinosol	1 in 1,000	Immediate effect; slight movement.
	1 in 5,000	All dead in 4 hours.

Cupurin	1 in 1,000 ..	All dead in 50 minutes.
Microcidine	1 in 10,000 ..	All dead in 20 minutes.
	1 in 20,000 ..	Dead in 50 minutes.
	1 in 40,000 ..	Dead in 2 hours 50 minutes.
Beta-naphthol	1 in 1,000 ..	Kills immediately.
	1 in 10,000 ..	Stopped swimming immediately.
	1 in 100,000 ..	Fibrillar twitching and wriggling in 1½ hours; motionless in 2 hours.
	1 in 200,000 ..	Swimming stopped in 1 hour; quite motionless in 2 hours.
Emetin	1 in 2,000 ..	Dead in 30 minutes.
	1 in 10,000 ..	Slight contraction at 50 minutes; dead in 3½ hours.
Thymol	1 in 1,000 ..	Kills immediately.
	1 in 10,000 ..	All movement stopped in ¼ hour; dead in ¾ hour.
	1 in 20,000 ..	Swimming stopped in 2 minutes; some creeping.
	1 in 40,000 ..	Body disintegrated in 1 hour.
Fresh chlorinated lime ..	1 in 30,000 ..	Kills at once.
	1 in 50,000 ..	Dead in 3 minutes.
	1 in 300,000 ..	Actively swimming after 1¼ hours.
	1 in 500,000 ..	Active after 2½ hours.
Sodium hydroxide ..	1 in 1,000 ..	Immediate immobilization.
	1 in 5,000 ..	Actively swimming after 2 hours.
Chloroform water ..	1 in 1,000 ..	Paralyzes swimming; ineffective creeping movements. On addition of water swimming regained in 5 minutes.

EFFECT OF TEMPERATURE ON METAMORPHOSIS.

Many trematodes undergo their larval metamorphosis in molluscs during certain months of the year. Looss [290] remarked that in Egypt when the temperature falls in winter to about 5° to 6° C. the growth and multiplication of larval trematodes is sometimes wholly suspended, while in Central Europe it is only retarded at this temperature. Autumn seemed to be the most favourable period for fresh infections of intermediate hosts. During winter young parasites develop little by little but only reach the stage of cercarial production in the warm season. The appended table shows the monthly variations in the temperature of water near Cairo.

During February we found sporocysts containing secondary sporocysts and bifid-tailed cercariæ in *Planorbis mareoticus*. In March eyed bilharzia cercariæ were found also in this species. Non-eyed bilharzia cercaria were first detected in *P. boissyi* on April 17 and in *Bullinus* on June 8. Once located, the cercariæ were obtainable when desired up to the time of our departure in July. In would appear, therefore, that infection is by no means

confined to the autumn as has been generally supposed, but may be contracted during the greater part of the year.

Penetration. Free swimming cercariæ could not be recovered from infected waters, as they pass through the finest silk mesh. They readily pass through stocking material, and, given time, will succeed in traversing several inches of sand if there is a continuous flow of water through it. Unlike the ankylostome larvæ, they are unable to traverse ordinary filter-paper.

Temperature of Nile Water at Hawamdia, near Cairo.

	6 a.m. (deg. C.)	4 p.m. (deg. C.)
January	14·2	14·8
February	10·3	12·9
March	16·1	16·1—18·6
April	20	21·8
May	22·4	24·4
June	25·7	27·4
July	26·7	28·1
August	26·8	27·8
September	25·5	26·5
October	25	25·5
November	21·9	21·9
December	16·8	17

(From "The Physiography of the Nile," by G. H. Lyons.)

Practical Conclusions.

From the above it may be concluded that unfiltered water taken from canals, ditches, or birkets would be rendered safe:—

(1) If kept beyond the survival period of the cercaria, i.e., for forty-eight hours.

(2) If heated to 50° C., a temperature at which the cercaria is immediately killed.

(3) If previously treated with those chemicals that are lethal to the cercaria.

The chemical sterilization of water is chiefly effected by the use of (*a*) sodium bisulphate, and (*b*) chlorine. These two substances react upon cercaria very differently in the strength at which they are more commonly used for the destruction of bacteria in water.

Chemical Sterilization. (*A*) Sodium bisulphate is used in "tabloid" form to sterilize water for drinking purposes. Two "tabloids" are dissolved in a quart water-bottle as a rule. Each "tabloid" contains 16 gr. (1 grm.). This gives a dilution of 1 in 567. In a previous paragraph it was shown

that a dilution of 1 in 1,000 was quickly lethal to the bilharzia cercaria. These "tabloids" may therefore be used with safety in bilharzia-infected countries.

(*B*) The germicidal value of chlorine for *Bacillus coli* according to Captain Nesfield is 1 in 760,000 acting for ten minutes. 1 in 1,000,000 acting for half-an-hour is in common use. There is one part of available chlorine in three parts of fresh chlorinated lime. One part of chlorinated lime in 300,000 with half-an-hour's contact is therefore an efficient bactericide. From the tabulated effects of chemical reagents on the cercaria it will be seen that this dilution would not have the slightest effect upon the activity of the bilharzia cercaria. It would be necessary to use twenty parts of bleaching powder per 1,000,000, and afterwards to dechlorinate in order to render water taken from the canals and ditches in Egypt free from bilharzia infection.

Attention should be given to the following points :—

(1) Personal contact of any kind with unfiltered water is risky. The surface of the water is the most likely to be infective as the cercariæ congregate there. An intake pipe should always be led therefore to the centre of the stream and should draw the water from near the bottom and at a place where there is little or no vegetation.

(2) It is essential in drawing water for storage, in order to destroy the bilharzia cercaria, that no infective mollusc be admitted. This can be ensured by screening the intake pipe with gauze having about sixteen meshes to the linear inch. The common mosquito gauze or phosphor-bronze wire gauze is very serviceable.

(3) The water in the wells and "sakias" may be regarded as much safer than that from other sources. Hitherto molluscs have not been found in these wells.

(4) Shallow barrel sand-filters are open to suspicion. It has been found experimentally that after fifteen minutes cercaria succeed in passing in large and increasing numbers through four inches of desert sand.

(5) Although the reproductive activity of bilharzia in the molluscs is probably most intense during the summer months the occurrence of mature cercariæ in infected molluscs in February shows that there is a certain liability to the infection throughout the year.

(*To be continued.*)

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(*To be continued.*)

THE CAUSATION AND PREVENTION OF ENTERIC FEVER IN MILITARY SERVICE, WITH SPECIAL REFERENCE TO THE IMPORTANCE OF THE CARRIER.

Being an Account of Work done at Naini Tal Enteric Depot, 1908-11.

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(*Continued from p.* 120).

Notes on Carriers at the Depot in 1908.

(1) On April 27, Private H., Bedford Regiment, was found to be passing typhoid bacilli in his fæces. This man had had a severe attack of enteric fever in Jhansi in March, 1907, and had been at Kasauli from June, 1907, to March, 1908. He arrived at Naini Tal in April, 1908. While at Kasauli his excreta were for a time examined daily, and he passed typhoid bacilli frequently, at first both in his fæces and urine, latterly only in his fæces and at longer intervals. The bacillus was again isolated from the stools at Naini Tal on several occasions, and as there was no doubt that this man was a chronic carrier, his name was submitted to headquarters, and he was invalided home in November, 1908. This man looked pale, but stated that he felt perfectly fit. He had no symptoms of cholecystitis, and as his serum only gave a low index for typhoid, there was really no indication of his condition. A vaccine was prepared from the strain isolated from the fæces, but owing to pressure of other work I was unable to proceed with this line of treatment.

On November 25, 1908, the day before he left the depot for England, the *Bacillus typhosus* was again isolated from the fæces.

	Agglutination.					
	20		40		100	
Stock strain	..	+	..	−	..	−
Own strain	..	−	..	−	..	−

Phagocytic index, average five per cell.
Opsonic index, average less than one per cell.

The examinations of this man were continued in England, He was invalided out of the Service in 1910, and is still a carrier (1911).

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[1] Now Lieutenant-Colonel.

(2) On July 17, Private L., 1st Bedfordshire Regiment, came sick complaining of pain in the right hypochondrium. His fæces were examined on the following day, but no typhoid bacilli were found. On the next day, however, numerous typhoid colonies were evident. This man had a severe attack of enteric fever in Jhansi in April, 1907, and on arrival at Kasauli in June had a severe attack of cholecystitis with fever, and there were large numbers of typhoid bacilli in his fæces. He arrived at Naini Tal in April, 1908. He looked quite fit, but from time to time got attacks of cholecystitis, which were a clue to his condition. These attacks became less severe and were latterly not so frequent. It was during one of these attacks at Naini Tal that the *B. typhosus* was recovered from his fæces one year and four months after his fever. He was invalided to England in November, 1908.

Agglutination.

	20	40	100	200	400
Laboratory strain ..	± ..	± ..	± ..	± ..	Trace

Phagocytic index, average per cell, 17.

(3) On September 1, Gunner C. was found to be passing typhoid bacilli in his fæces in large numbers. He had been admitted to the Station Hospital, Meerut, in March, 1908, and passed through a severe attack of fever. He was a constant carrier. The examinations of the urine were negative. He occasionally had slight looseness of the bowels, but had no cholecystitis, and he was invalided home in November, 1908.

Agglutination.

	20	40	100
2.7.08.			
Stock strain ..	± ..	± ..	±
Own strain ..	− ..	− ..	−
14.11.08.			
Stock strain ..	+ ..	± ..	±
Own strain ..	+ ..	± ..	−

(4) On September 3, 1908, Bombardier S. was found to be passing typhoid bacilli in his urine in pure culture. This man had been admitted to hospital in Fyzabad in May, 1908. He proved to be a constant carrier. The urine was invariably perfectly clear to the naked eye and contained no albumin or pus and was acid in reaction. He was invalided to England in December, 1908.

(5) On November 20, 1908, Private O'N., the Cameronians, was found to be passing a bacillus, resembling the *B. typhosus*, in his fæces in small numbers, and again on November 26 the same

bacillus was isolated. This man had passed through a mild attack of fever in Cawnpore in 1908. He was invalided to England as a carrier in December.

The excreta of this man was examined in England frequently after his arrival. The *B. typhosus* was never found, and he was accordingly returned to duty.

I believe in this case I was misled by a bacillus closely resembling the *B. typhosus;* it was at once agglutinated macroscopically by high titre typhoid serum, and the serum of Private O'N. agglutinated this bacillus in the same dilutions as it did the stock *B. typhosus.* The sugar reactions were apparently correct, but at this time nutrose water sugar tubes were used instead of peptone water. I am convinced that if time had permitted further investigations, such as repeated and prolonged tests in the sugar tubes, with absorption experiments, the mistake would have been obviated. Even now after the lapse of four years I have a very distinct recollection of remarking that the colonies of this bacillus owed their transparency to the fact that they were flat and thin, whereas true typhoid colonies, although possessed of a good body, have, as it were, an inherent transparency. I am quite certain that I have met with this bacillus on subsequent occasions in other cases, but was able to overcome the difficulty of differentiation by fuller investigation.

	Agglutination.		
	20	40	100
Stock strain	+ ..	± ..	−
Own strain	+ ..	± ..	−

In 1909, as already mentioned, the improved equipment being available, a great many more examinations were made, with the result that during the year the fæces and urine of three hundred and sixty men were examined on an average twelve times.

Eight thousand two hundred samples of excreta were examined and six carriers of bacilli of the typhoid group were detected. Notes of the cases of these men are appended.

Conradi's new brilliant green medium was given an extended trial, but was abandoned in favour of the original blue medium, for the following reasons:—

(I) Its use involves more expense, as a large quantity of peptone is required.

(II) *Coli* colonies do grow on it although not so freely as on the old (one-third less), but as they and also the typhoid colonies are inhibited they cannot readily be distinguished.

(III) When it is necessary to examine fifty or sixty plates daily it is essential that one should be able to pick out, after twenty-four hours' incubation, likely from unlikely colonies. This is possible on the old, not on the new medium.

In addition to the routine work of the depot, a small epidemic of paratyphoid fever was investigated, and as this was the first series of cases, diagnosed by cultural methods, described in India, some mention is made of it here. This also leads up naturally to a consideration of the paratyphoid problem in military service in India, a problem which has now assumed considerable importance.

These cases all occurred in a camp near Naini Tal, about four miles from the depot and on the opposite hill. One hundred and fifty men from the Lucknow garrison were accommodated in this camp during the hot weather.

The first case of fever was proved to be true enteric fever by the isolation of the *B. typhosus* from the blood. This was a mild case of fever and quite indistinguishable from the others on clinical grounds, except that the pulse-rate was slow throughout.

TABLE.

Name	Date of admission	Culture, Paratyphoid A		
		Blood	Fæces	Urine
Corporal H.	15.4.09	+ (in relapse)	−	−
Private P.	6.5.09	+	+	−
,, G.	16.5.09	+	−	−
Lieutenant P.	17.5.09	+	−	−
Serjeant B.	3.6.09	+	−	−
Private D.	1.7.09	+	−	−
,, F.	18.7.09	+	−	−
,, B.	22.8.09	−	+	+
Serjeant Br.	15.10.09	+	+	−

It will be noted that although in all cases the excreta of these men was examined daily from the time of admission to hospital and throughout the fever the *B. paratyphosus* A was only recovered in three cases from the fæces and once from the urine. The *B. paratyphosus* A was recovered from the blood in eight of the nine cases. One man became a carrier and continued to excrete the bacillus in his fæces for more than three months after the fever had ceased. He was sent home time-expired, so further examinations were not carried out. In another case (Private B.) the bacillus was found in the fæces for a month after the fever had ceased, but not later; and in the case of Serjeant Br. it was only found during the fever and not later.

The Widal reactions are given in tabular form :—

	Date of fever	Date of Widal	T. 1/20	T. 1/40	T. 1/100	A. 1/20	A. 1/40	A. 1/100
Case I	18.4	12.5	+	+	±	Trace	–	–
,, II	3.6	21.10	±	Trace	–	±	∓	–
,, III	9.5	11.5	+	+	±	±	∓	Trace
,, IV	16.5	9.6	±	±	∓	±	∓	Trace
,, V	17.5	23.5	±	∓	Trace	–	–	–
,, VI	1.7	9.7	±	Trace	–	–	–	
,, VI	1.7	29.7	±	Trace	–	–	–	–
,, VI	1.7	13.10	Trace	–	–	±	Trace	–
,, VII	18.7	1.8	±	±	Trace	Trace	Trace	–
,, VII	18.7	13.8	±	Trace	–	±	±	∓
,, VIII	22.8	4.9	+	+	±	±	+	Trace.
,, IX	15.10	18.10	±	±	Trace	±	±	–

In all cases the agglutination showed first in the 1 in 20 A tubes, even if the final result was only "Trace" 1 in 20. No comments are made on these reactions, as they are considered later when dealing with the paratyphoid problem generally.

It has been recognized in India for some years that the "pyrexias of uncertain origin" offered a rich field for investigation. In one large hospital where the writer was doing duty there were, in one six months, when no laboratory work was possible, one hundred and sixty-four cases of fevers of uncertain origin. In the following six months, when the laboratory and the "special" ward were in the hands of a trained worker there were only three such cases.

A large number of these fevers of uncertain origin are undoubtedly malarial in origin. In some hospitals only those cases of fever in which the malarial parasite has actually been demonstrated are diagnosed malaria. Many more will be accounted for by "sand-fly fever," and some by true influenza. But this will still leave some which are true paratyphoid fevers and mild enteric fevers. On the other hand, a considerable number of cases diagnosed as true enteric fever are really paratyphoid fevers.

There is, of course, little danger to the community in this particular error. At the same time, it is one which should not be permitted to occur, as it throws doubt on the efficacy of anti-typhoid inoculation. The writer is of opinion that a large percentage of the mild cases of enteric fever "modified by inoculation" are really paratyphoids.

The following figures are taken from the Annual Report of the Naini Tal Depot for 1911, by Captain J. L. Wood, R.A.M.C. :—

Of 18 enteric cases proved by blood culture, 9 were not inoculated; of 39 clinically enteric, 19 were not inoculated; of 85 paratyphoid cases proved by blood culture, 5 were not inoculated. Or to put it in another way: Of 57 enteric fevers 50 per cent. were inoculated; of 85 paratyphoid cases 95 per cent. were inoculated.

It will be readily understood that the differentiation of paratyphoid fever from true enteric is important, but the removal of the paratyphoids from among the pyrexias of uncertain origin is of vital importance.

The ætiology of typhoid and paratyphoid fever is similar, that is to say, in both cases man is the storehouse of the virus, and cases arise by contact with infected persons. This has already been shown in the instance of two small epidemics caused by acute or temporary carriers. Apparently temporary carriers are more common after paratyphoid fever than after typhoid; the difference, however, is only apparent and not real. Typhoid is, as a rule, a severe disease. It "bowls" its victim over and convalescence is slow and prolonged. The convalescent accordingly does not arrive at the depot until at least three months have elapsed since the cessation of his fever, thus eliminating at least 10 per cent. of carriers. On the other hand, paratyphoid fever is, as a rule, a mild affection, convalescence is remarkably rapid, and the men often arrive at the depot within a month *of their admission to hospital*, with the result that on arrival many are found to be excreting the bacillus, and continue to do so for short periods, thus giving the erroneous impression that temporary carriers are more common among paratyphoid convalescents than among the typhoid. If typhoid fever cases are examined in the first month of convalescence the proportion of temporary carriers is just as high.

This very mildness of the disease and rapid convalescence in paratyphoid fever constitutes a danger, as the correct diagnosis may not be made and the man may be returned to duty while still infective. It is therefore essential that every case of paratyphoid fever should be correctly and rapidly diagnosed if this fever is to be eliminated from the records as typhoid fever has been.

The writer would like to see paratyphoid fever stamped out of the Army without the aid of special inoculation, and this stamping out is possible by means of rapid and accurate diagnosis of all such cases, with their segregation and examination in the depots, and, as a matter of course, strict attention to all sanitary details.

This will mean, for a year or so, a slight rise in the incidence

of enteric fever, but if it is recognized that this is only a temporary one and is due to more accurate diagnosis of the unrecognized fevers, it will be an advance rather than a retrogression.

A disquieting feature of this question is the fact, as reported by Captain Wood, R.A.M.C., in his Annual Report of the Depot for 1911, that a considerable proportion of the bacilli, isolated by blood culture from cases of fever among sepoys of the Native Army, are paratyphoid A, but with the active co-operation of the I.M.S. officer this danger may also be eliminated.

The paratyphoid problem in India centres in the paratyphoid A variety, whereas in Europe the variety most commonly met with is paratyphoid B. In no authenticated case so far has the *Bacillus paratyphosus* B been isolated from the blood of a case of fever in India, and out of twenty-eight thousand samples of excreta examined at the Naini Tal Depot, and from which all non-lactose-fermenting colonies were investigated, the *B. paratyphosus* B was never met with.

Paratyphoid fever may be so slight that the man may never report sick, as already noted in a case described by Major Grattan and Captain Wood. Such cases will only be detected if they give rise to further cases.

Clinically, paratyphoid fever resembles a mild enteric fever, but differs in the following particulars: The onset as a rule is rapid and is frequently accompanied by a rigor (I have heard it said by officers that they have seen typical enteric fever in which the onset was rapid and accompanied by a rigor, but these were in pre-blood culture days), sore throat is a very common initial symptom, and the pulse-rate is as a rule more rapid (120) in the early stages than in uncomplicated enteric fever. Clear mental condition is a feature of all cases, and even in prolonged fever the typhoid state is not met with. Hæmorrhage is exceptional, but death from perforation of the only ulcer has been reported.

The writer has seen in two cases a morbilliform rash extending over the entire body, limbs, and face. In one of these cases this rash appeared during the fever, disappearing on defervescence and reappearing during a relapse, to disappear again when the temperature touched normal. The *B. paratyphosus* A was recovered from the blood both during the initial fever and again in the relapse.

Relapses are common, and inflammation of the veins of the leg may also follow, giving rise to a typical enteric leg.

The mortality is less than one per cent.

By a recent ruling (1910), only those cases are to be returned as paratyphoid fever in which the bacillus has been recovered from the blood. It is not possible to do a blood culture in every case at the commencement of the fever, and, therefore, if the above ruling is rigidly adhered to many cases of paratyphoid fever, which could be definitely diagnosed on clinical grounds combined with the Widal reaction, will be included among pyrexia of uncertain origin. Even if these cases were regarded as dangerous it would not be possible to keep them long enough in hospital to ensure safety.

During the year 1911 one hundred and thirty-eight cases of fever were sent up to the depot as probably paratyphoid fever, although in all blood culture had been negative. Of these, five were found to be excreting the *B. paratyphosus* A, and one of these men continued to excrete this bacillus for six months after his fever.

Blood culture should be attempted in every case at the earliest opportunity, but if this fails it is quite possible to diagnose paratyphoid fever on clinical grounds in combination with a close study of the Widal reactions. This Widal reaction in paratyphoid fever (A variety) is peculiar, and in the writer's opinion specific. A study of the Widal reactions in over one hundred cases has shown that in the early days of the fever the agglutinins are not present, but as a rule the group reaction for *B. typhosus* begins to appear before the specific reaction for paratyphoid A. This group reaction for the *B. typhosus* may reach as high a titre as that obtained in an attack of true enteric fever—i.e., up to a dilution of 1 in 200. The reaction for paratyphoid is, as a rule, lower, and may only be demonstrated in such dilutions as 1 in 20 or 1 in 40, and only exceptionally complete in either. A peculiarity of this reaction is that almost invariably the agglutination commences first in the sedimentation tubes which contain the lower dilutions of paratyphoid serum, whereas the agglutination in the typhoid tubes does not show until some hours later. This paratyphoid agglutination appears as a faint feathery haziness up and down the tube within half an hour of mixing the emulsion with the serum. The typhoid reaction may not appear until the following day, when it may be complete in 1 in 40 dilution and nearly complete in 1 in 100, whereas, little further change takes place in the A tubes—i.e., 1 in 20 incomplete, 1 in 40 a trace. When the writer first noticed this phenomenon, he was in the habit of putting up higher dilutions, in order to obtain an end-point, only to find that the original 1 in 40 was quite sufficient for this purpose.

The agglutination reaction for paratyphoid A is frequently transient and may only be present for a few days in the later stages of the fever, or in early convalescence, and in most cases it disappears entirely in a few weeks, although in one case the writer found it still present one year after the fever. The group agglutinins for *B. typhosus* produced by an attack of paratyphoid fever also disappears quickly, in contrast to the specific agglutinins for typhoid, produced by an attack of true enteric fever, which remain for months and years in some cases. This rapid disappearance of both specific and group agglutinins accounts for the apparent anomaly of a man passing through what was, clinically, a mild attack of enteric fever, and yet giving a few weeks later an entirely negative Widal reaction. This has happened at the depot in several cases in which the *B. paratyphosus* A has been isolated from the blood during the fever and whose serum had given a high Widal reaction for both bacilli. Or, again, both reactions may be so slight or transient during the fever and convalescence as to be ignored and returned as negative. This happened in the experience of the writer in one case at least before he realized that a reaction in a dilution of 1 in 20 for paratyphoid A is not unimportant.

It will be seen from the above remarks that the accepted teaching regarding Widal reactions holds good so far as typhoid is concerned—i.e., a case should not be diagnosed as enteric unless a reaction is obtained in a 1 in 100 dilution; but not so in paratyphoid A, as in this instance a reaction in a 1 in 20 dilution, even although it be not complete, should not be ignored.

Absorption experiments were also carried out in some cases, to determine the group and specific agglutinins, and examples of some of those are appended.

In cases due to infection with the *B. paratyphosus* A whose serum agglutinated both the paratyphoid A and typhoid, absorption with A removed all the agglutinins, or if the man had been inoculated reduced those for typhoid to the level that obtained before the fever. Absorption with *B. typhosus* removed only the group agglutinins for this bacillus but not those for *paratyphosus* A, even although these had only been present in a 1 in 20 dilution. This rule, however, is not invariable, as in some cases the titre for paratyphoid A was considerably reduced by absorption with the *B. typhosus*, although the cases had been proved by blood culture to be true paratyphoids; but this was exceptional. Curiously enough, group agglutinins for A in typhoid cases were only very rarely met with.

Absorption Experiments.

Private K.'s serum. Chronic carrier, *Bacillus paratyphosus* A. Twice inoculated against enteric fever.

		Dilution 20	40	100
Before absorption	T.	±	±	Trace.
	A.	±	±	..
After absorption with *Bacillus typhosus*	T.	–	–	..
	A.	±	–	..
After absorption with *Bacillus paratyphosus* A	T.	+	–	..
	A.	–	–	..

Serjeant B.'s serum. Carrier of paratyphoid A.

		Dilution 10	20	40	100
Before absorption	T.	+	+	±	∓
	A.	±	∓		..
After absorption with *Bacillus typhosus*	T.	–	–	..	..
	A.	±	∓	–	..
After absorption with *Bacillus paratyphosus* A	T.	..	–	–	..
	A.	–	–	–	..

Serum of Private J. Typhoid convalescent.

		Dilution 10	20	40	100
Before absorption	T.	+	+	∓	–
	A.	±	∓		..
After absorption with *Bacillus typhosus*	T.	–	–	..	..
	A.	–	–	..	..
After absorption with *Bacillus paratyphosus* A.	T.	+	±	∓	–
	A.	–	–	–	..

During the year 1908 it was specially noted that paratyphoid cases were not to be sent to the depot, as there was barely accommodation for the true typhoids, and it was well known that an attack of paratyphoid fever did not protect against true enteric.

In spite of this, several men were sent up to the depot as enteric fever convalescents who had had paratyphoid fever, and one of these, Private H., Sussex Regiment, contracted typhoid fever in the depot, the *B. typhosus* being recovered from his blood and fæces. This man on arrival at the depot gave a completely negative Widal reaction, although his chart was typical of a mild enteric fever (fifteen days' fever) and his Widal reaction during his fever was returned as positive 1 in 40, *B. typhosus*.

On looking over the charts of the men who were in the depot in 1908 in the light of more recent experience, the writer is of opinion that there were about fifty cases sent up which were probably paratyphoid, whereas in 1910 there were over one hundred diagnosed by blood culture and Widal reaction. (In that year, 1910, paratyphoid cases were received at the depot.) In 1911

there were no fewer than two hundred and sixty-three paratyphoid fever convalescents at Naini Tal.

The figures for 1911 were as follows :—

	Enteric fever	Paratyphoid fever
Blood culture ..	18	.. 90
Clinically	39	.. 173
	57	.. 263

It will be noted that in the year 1911, from the whole of Northern India, out of one hundred and eight (108) cases of successful blood culture, ninety were due to *B. paratyphosus* A, and eighteen due to the *B. typhosus*, although it is obvious that the latter is much more readily recovered from the blood as it is present therein for a much longer period than is the former.

There can be little doubt, then, that, thanks largely to preventive inoculation and segregation of convalescents, true enteric fever has practically disappeared from among the troops in India, whereas if paratyphoid fever has not increased it has certainly not diminished. This is, to my mind, the very strongest argument possible that the recent remarkable reduction of enteric fever is due almost wholly to inoculation. If, however, segration and removal of carriers is given fair play against paratyphoid fever as it has been against typhoid, then the former disease will also soon disappear from the records and the paratyphoid problem will be solved.

Notes on Carriers Detected during the Year 1909.

That the coming event of paratyphoid incidence was already casting its shadow before was evidenced by the fact that out of the six carriers detected, three were carriers of paratyphoid bacilli, two of the typhoid bacillus, and one had a chronic bone infection due to the *B. typhosus*.

Case 1.—Private B., Highland Light Infantry, was admitted to hospital in Darjeeling in September, 1908. He had a prolonged fever of a remittent and occasionally intermittent character. During convalescence his pulse-rate was rapid. He arrived at the Naini Tal depot on December 12, 1908. On examination of his urine it was found that he was passing a bacillus resembling the *B. paratyphosus* B in the appearance of the colonies. These colonies where closely packed were small, blue, and transparent, but where they had room to grow out showed a definite greyish-purple centre. The urine was turbid and contained a small quantity

of albumin. On centrifuging, a few pus and blood cells were seen and an occasional tube cast (blood). A count of the urine showed that there were forty million bacilli per cubic centimetre present, on an average.

On January 12, 1909, his serum gave the following agglutination reactions :—

	1/20	1/40	1/100
Bacillus typhosus ..	Trace ..	− ..	−
Paratyphoid A	+ ..	+ ..	±
Paratyphoid B	− ..	− ..	..
Urine bacillus	± ..	∓ ..	Trace

The bacillus isolated from the patient's urine gave the following reactions :—

A short, thick, feebly motile Bacillus, non-Gram-staining.

	24 hours	48 hours	5 days
Lactose	Faint acid, no gas ..	A + G ..	..
Glucose	A + G ..	A + G ..	..
Maltose	A + G ..	A + G ..	..
Mannite	A + G ..	A + G ..	..
Saccharose ..	A + G ..	A + G ..	..
Litmus milk ..	Acid ..	Acid, no clot ..	Acid, no clot.
Peptone water ..	− ..	− ..	Indol, trace.
Neutral red agar ..	Gas and fluorescence ..	.. ..	..
Gelatine	No liquefaction ..	.. ..	..

Conradi's blue medium : Small colonies, blue and transparent.

Plate culture : Large colonies, purple-grey centre.

Neutral red agar plates : Clear transparent colonies, no red centres even after five days.

Coli colonies on the same medium showed a bright red centre in twenty-four hours.

The subcutaneous injection of three cubic centimetres of a forty-eight hours broth culture had no effect whatever on a young guinea-pig. The bacillus was not agglutinated either by typhoid or paratyphoid high titre serum. Urotropine, ten grains three times a day for a fortnight, and then twenty grains t.i.d. for three days, was given, but the drug had no effect whatever on his condition.

In March, 1909, a vaccine was prepared from the bacillus isolated from the urine, the growth on an agar tube being scraped off into eight cubic centimetres of normal saline solution and sterilized by heating to 58° C. for one hour. A dose of, approximately, three hundred million bacilli was given subcutaneously on March 16. There was a marked local and general reaction which, however, was not followed by any amelioration of the renal condition.

His agglutination reaction on March 27, 1909, was as follows:—

	1/20	1/40	1/100
Bacillus typhosus ..	Trace	−	−
Paratyphoid A	+	±	Trace
Own bacillus	+	±	∓

Serum of a Convalescent from Enteric Fever.

	1/20	1/40	1/100
Bacillus typhosus ..	+	±	Trace
Paratyphoid A	−	−	..
Urine bacillus of Pte. B...	±	±	∓

On March 30, 1909, a second dose of vaccine was given. No reaction beyond a slight local one followed this inoculation, and it had no effect on the excretion of the bacillus.

In July, 1909, Private B. was discharged from the depot quite well "in himself," but still passing the bacillus in his urine in large numbers. From December, 1908, till July, 1909, the bacillus was invariably present from day to day and always in pure culture on Conradi plates. In 1910 this man died of meningitis, but, unfortunately, as he died at an out-station, no cultures were made *post mortem*, and no cause for the meningitis was given. I think there can be little doubt that the causal organism was the one which had established so firm a hold on his kidney.

Case 2.—Gunner S. arrived at the depot on April 8, 1909, from Meerut, where he had suffered from a severe attack of enteric fever. It was stated on his case-sheet that he had suffered from periostitis. On arrival at the depot he had several nodes on the tibia and ulna, and about a week later he developed a painful swelling on a metacarpal bone. A needle was inserted into this, but no fluid could be obtained and no growth resulted from the cultivation.

On June 16, 1909, three months after his arrival at the depot, and six months after his attack of fever, he was struck on the shin over the site of one of the nodes by a football. This node became inflamed and a small abscess resulted. Some of the pus was drawn off by a syringe and a pure growth of the *B. typhosus* was obtained both in bile and directly on a Conradi plate. As he had at least six of these nodes remaining he may fairly be classed as a chronic carrier (osteal) of the *B. typhosus*.

Case 3.—Private P., Royal Dragoons, was admitted to the Station Hospital, Naini Tal, on April 10, 1909. The *B. paratyphosus* A was isolated from his blood. He made a good recovery,

but during convalescence suffered from attacks of fever with cholecystitis, and the *B. paratyphosus* was present in his fæces for more than three months. He proceeded home, time-expired, in October.

August 10, 1909. Agglutination reactions :—

Dilution of serum	1/20	1/40	1/100
Stock *B. paratyphosus* A. ..	± ..	Trace ..	–
Private D.'s strain* ..	± ..	± ..	Trace
Own strain	± ..	± ..	,,
Private F.'s strain*	+ ..	± ..	∓
Stock *B. typhosus*†	+ ..	+ ..	±

* Strain isolated from the blood of other cases in the same small epidemic.

† Private P. had *not* been inoculated against enteric fever.

Case 4.—In March, 1909, Gunner S., 58th Battery, Royal Field Artillery, was found to be passing the *B. typhosus* in his fæces daily and almost in pure culture. He had no symptoms of cholecystitis and was invalided home at once.

Case 5.—Private W., Durham Light Infantry, arrived at the depot on June 2, 1909, from Nasirabad, where he had suffered from a very severe attack of enteric fever.

June 12, 1909. Widal reaction :—

	1/20	1/40	1/100
B. typhosus	+ ..	+ ..	+

Not tested for paratyphoid.

In due course his fæces and urine were examined, and the *B. paratyphosus* A was recovered from his fæces on several occasions in September, eight months after the fever.

September 12, 1909. Widal reaction :—

	1/20	1/40	1/100
B. typhosus	+ ..	± ..	Trace
B. paratyphosus A	+ ..	± ..	∓
Own strain	+ ..	+ ..	+

It will be noted that this man's serum agglutinated the stock paratyphoid A in higher dilutions than did the serum of the more recent cases of fever.

Private W. stated that he suffered from morning headaches and had never felt fit since the attack of fever. On examination a tender spot was found in the gall-bladder region.

Although the bacillus isolated from the man's fæces resembled the *B. paratyphosus* A in culture reactions and morphologically, it differed somewhat in its agglutination reactions, as it was readily

agglutinated by normal human serum. Two cubic centimetres of a broth culture of this bacillus when injected into a guinea-pig did not kill it, but produced agglutinins for the stock *B. paratyphosus* A; and absorption of the high titre serum by this bacillus removed both the specific and group agglutinins.

Case 6.—On December 6, 1909, Private C., 12th Lancers, arrived at the depot from Sialkot, where he had fever in September. When riding up from the station to the depot he was suddenly seized with acute pain in the right side and fainted. He was brought up to the depot in a dhooly. When examined there was tenderness and rigidity of the right side of the abdomen, and he complained of great pain in the right iliac fossa. He had a temperature of 101° F., and his blood showed a marked leucocytosis. As he had had an appendix abscess opened three years before without removal of the appendix, it was thought that this attack might be due to a recurrence of the old trouble, but on an examination of his fæces the *B. typhosus* was found in very large numbers, and the following day the pain had definitely located itself in the gall-bladder region. He made a good recovery, but continued to excrete the *B. typhosus* in his fæces daily and almost in pure culture. A vaccine was prepared from his own strain and he received five doses at intervals of ten days, three hundred million bacilli in the dose, but no improvement took place in his condition, and he proceeded home, time-expired.

In the year 1909, in addition to these typhoid carriers, two other interesting cases were reported.

(1) Chronic carrier, amœbic. This man had suffered from dysentery before arrival at the depot, and while in residence there had several short attacks easily controlled by ipecacuanha. During these attacks amœbæ were present in large numbers in the stools. The interesting point was that during the intervals, when his fæces were normal, amœbæ were freely present.

(2) Several instances of apyrexial malarial carriers were also noted and reported.

In the year 1910, 239 men arrived at the depot, and 253 were examined and sent down; 3,574 samples of fæces and 3,219 samples of urine were examined. The excreta of each man was examined on an average fourteen times; 6 carriers of bacilli of the typhoid group were detected, 2 were typhoid carriers (fæcal) and 4 were paratyphoid (also fæcal). It is interesting to note that out of the 239 cases sent up to the depot more than 100 were, from a study of the charts and case-sheets and Widal reactions, due to the

B. paratyphosus A. This is also evidenced by the fact that of the 6 carriers detected 4 were paratyphoid.

During the year an extended trial was given to Fawcus's modification of Conradi's medium. The use of this medium was, however, not continued, for the same reasons that were adduced in the case of Conradi's own green medium: (1) Expense; (2) inhibits both *coli* and typhoid; (3) necessity of incubating more than twenty-four hours.

Padlewski's medium was also given a trial. This is a good medium when only a few plates are required, as the typhoid colonies are large and characteristic in twenty-four hours, but it is more expensive and more difficult to make in large quantities than the blue medium, and is also more liable to become overgrown.

A further series of experiments to test the viability in nature in the fæces of chronic carriers of the *B. typhosus* and *B. paratyphosus* A were also carried out, and the results have been recorded above.

Notes on Carriers discovered during 1910.

Case 1.—No. 9273, Private H., King's Liverpool Regiment, arrived at the depot on September 19, 1909, but owing to the large number of men in the depot at that time it was not possible to examine him until January, 1910, when he was at once found to be a constant carrier (fæcal) of the *B. typhosus*. He had had a severe attack of fever in Subathu in May, 1909, and during the fever had been treated with doses of curative vaccine. The question has suggested itself, had this treatment anything to do with his subsequent condition as a carrier? He had two or three definite attacks of cholecystitis, diagnosed as malaria, at Subathu during convalesence.

On October, 1909, he was admitted to the depot hospital in a comatose condition, with a temperature of 101° F. There were no malarial parasites in his blood and no quinine was given. His pupils were equal but inactive, and his knee-jerks absent. Forty-eight hours after his admission to hospital he quite suddenly woke up and had no recollection whatever of his illness. It was thought at the time that his condition was due to a blow on the head, of which there was a doubtful history but no marks. It is just possible, however, that this illness may have been due to his condition as carrier, of which one was not aware at the time. He made a good recovery, and there were apparently no after-effects, although at no time was his mental condition bright. As soon as it

was known that he was a carrier he was put on vaccine treatment in February, eight months after his fever. He received two courses of five doses of autogenous vaccine, but although his opsonic index was markedly raised the treatment had no effect on the excretion of the *B. typhosus*. He was invalided home *in statu quo*.

Case 2.—Colour-Serjeant W., King's Own Regiment, arrived at the depot on February 1, 1910, from Lucknow; here he had had a fairly severe attack of fever in December, 1909. There was a history of cholecystitis during the fever. He was examined at once on arrival at the depot, and was found to be excreting the *B. typhosus* in large numbers in his fæces daily. He was at once put on vaccine treatment—i.e., within two months of the cessation of his fever—and received four doses of autogenous vaccine, three hundred million bacilli in each dose, during February and March. At the end of March he quite suddenly ceased to excrete the *B. typhosus*, and although examinations were continued till October, all were negative. He was then allowed to rejoin his unit.

In July, Colour-Serjeant W.'s wife was allowed to join him in the depot, where they lived together till October. Mrs. W. had never had enteric fever, but had been recently inoculated. She never had fever in the depot.

As this man had fever in December it will be noticed that he only continued to excrete the bacillus for three months, and therefore it is possible that his was a spontaneous cure. At the same time, as the vaccine treatment was begun at the earliest possible moment, it may be conceded that it was at any rate a factor in the successful result.

Case 3.—Private M., King's Dragoon Guards, arrived at the depot on July 7, 1910, from Umballa, where he had had a severe attack of fever in April, which had been diagnosed as true enteric on the clinical signs and Widal reactions; but on his arrival at the depot his serum gave the specific reaction for paratyphoid A, and on examination of his fæces this bacillus was found almost in pure culture. This man was also at once put on treatment by autogenous vaccine. As this was the first case treated by a paratyphoid vaccine, the initial dose was fifty million bacilli, increased later to one hundred million, but no larger dose was given, as even with the first dose there was a considerable local and general reaction. This man at the time was somewhat anæmic and debilitated, due to syphilis, and he subsequently developed a gumma of the foot. Therefore, perhaps he was not a very suitable subject for vaccine treatment. He received in all four doses of vaccine,

and ceased quite suddenly to excrete the *B. paratyphosus* A in October, 1910, having been a carrier for six months. This man's general condition was much improved during his course of vaccine treatment, as he put on weight and gained colour in quite a remarkable manner.

Case 4.—Lance-Corporal D., 8th Hussars. The serum of this man had given a positive reaction for the *B. paratyphosus* A while in hospital. As the blood culture was negative his case was diagnosed "pyrexia of uncertain origin," but as the senior medical officer and the medical officer in charge of the case were of the opinion that he had suffered from paratyphoid fever he was sent up to the Station Hospital, Naini Tal, for further examinations. His excreta were examined at least four times with negative results, but as his serum still gave a positive reaction to the *B. paratyphosus* A, he was sent out to the depot on August 19, 1910. On arrival there his excreta were again examined for one week, with negative results. But when he came up for his final examination six weeks later he was found to be passing the *B. paratyphosus* A in his fæces in large numbers. He was, therefore, an intermittent carrier and only passed the bacillus at intervals during one month, all subsequent examinations up to March, 1911, were negative, and he was then returned to duty. He was not treated with vaccines, but ceased spontaneously to excrete the bacillus. This type of case is a difficult one to legislate for, as ten examinations made during early convalescence were negative, and had the patient been discharged then, he would subsequently have become a danger to others.

Case 5.—The case of Private K., Middlesex Regiment, has already been referred to. Four months after his fever he was still excreting the *B. paratyphosus* A, but ceased spontaneously about a fortnight after his arrival at the depot. He had been discharged to duty in the early weeks of convalescence while still infective and caused twelve cases of fever in his barrack-room.

Case 6.—No. 9218, Private B., 2nd East Surrey Regiment, arrived at the depot on November 6, 1910, from Mhow. On examination he was found to be passing the *B. typhosus* in his fæces practically in pure culture. He was anæmic, and complained of pain in the gall-bladder region. He was given a thorough course of vaccine treatment, begun at the very earliest opportunity, but although he improved greatly in general health the treatment had no effect on the excretion of the bacillus, and he was invalided home in October, 1911.

Treatment of Chronic Carriers.

Five chronic carriers (fæcal) were treated by repeated doses of autogenous vaccines. Of these five, two cleared up while under treatment, while three remained *in statu quo*. The two who ceased to excrete the bacillus while under treatment, one typhoid and one paratyphoid, had perhaps not been long enough after the fever to be reckoned as definite chronic carriers. One ceased three months and one six months after the fever, and therefore a spontaneous cessation could not be excluded. On the other hand, of the three who were not cured by the vaccine, treatment had been commenced in two instances within six weeks after defervescence.

Although these results are not very encouraging, still I believe it is worth while to persevere with this line of treatment, especially if the cases can be got in the early stages of the condition. At least one or more cases may be met with in which the chances for or against the man becoming a carrier are very evenly balanced, and a dose of vaccine may just determine a cure.

The opsonic index had apparently no correlation with the cessation of excretion, as in at least two instances the serum of the men who continued to excrete the bacillus gave a much higher reading than did that of the two who had been cured.

For the notes of the work in the depot at Naini Tal for 1911 the writer is indebted to Captain J. L. Wood, R.A.M.C., who took over charge in March of that year.

During the year 323 men arrived at the depot, and 285 were examined and sent down ; 5,979 samples of fæces and 4,375 samples of urine were examined.

During the three years that the depot had been in action the number of examinations had been gradually increased. In the first year (1908) only the nine-inch plates were available, and two of these were used for each sample of fæces. As it was only possible to get twenty plates into the incubator, it will be understood that the examinations were limited in number. In the following year two gross of six-inch plates were received and also an incubator capable of holding eighty of these plates. At this time three plates were used for fæces and one for urine, so that twenty examinations daily were possible.

By careful calculation of the dilutions of the fæcal samples, it was possible to use only one plate for each fæcal sample and one small three-inch plate for the urine. By this means, without increasing the amount of medium expended, it was possible to increase greatly the number of examinations.

In 1911 accommodation was provided for officers convalescent from enteric fever, and five were received and examined. Quarters for women and children are also being built, but had not been completed by the end of 1911.

The cases received at the depot in 1911 were classified as follows :—

Paratyphoid fever	90
Enteric fever	95
Pyrexia of uncertain origin, suspected to be paratyphoids	198

Captain Wood divides up the typhoid cases as follows :—

Confirmed by blood culture	18
Clinically and by Widal	39
Probably paratyphoid	35
Probably neither	3
	95

Of the one hundred and thirty-eight cases sent up as pyrexia of uncertain origin, five were found on arrival to be excreting the *B. paratyphosus* A in their fæces, and one man continued to do so for more than six months after his fever; a very shrewd commentary on the risk of relying on blood culture alone for a diagnosis.

It is practically certain that if these cases had occurred two or three years earlier, before attention was directed to the paratyphoid fevers by the work done at the Naini Tal depot, they would not have been regarded as dangerous, and would have been returned to duty as soon as physically fit, with the result that numerous fresh cases would have arisen.

Amongst the cases diagnosed as enteric fever on clinical grounds plus Widal reaction, one man was found to be a temporary carrier of the *B. paratyphosus* A.

In this year (1911) *no* carriers of the typhoid bacillus were detected; but it must be remembered, as already pointed out, that convalescents from true enteric fever are not sent up to the depot until at least six weeks after their fever had ceased, and thus the majority of temporary carriers have been already eliminated.

No fewer than twelve men were found to be temporary carriers of the *B. paratyphosus* A. All, with one exception, ceased to pass the bacillus within two months of their arrival. One man was still a carrier six months after his fever. None were treated by vaccines.

WIDAL REACTIONS OF CARRIERS OF PARATYPHOID A.

	B. typhosus			*B. paratyphosus* A		
	1/20	1/40	1/100	1/10	1/20	1/40
Private C.*	+	+	−	−	−	
,, E.	+	+	−	−	−	−
,, D. ..	+	−	−	−	−	−
,, McK. ..	±	+	Trace	∓	−	−
,, J.	+	∓	±	Trace	−	−
,, S.	±	±	∓	±	∓	−
,, H. ..	+	±	∓	∓	−	−
,, Jo. ..	+	∓	Trace	±	+	−
,, A. ..	±	±	±	+	+	∓
,, McK. ..	±	∓	Trace	−	−	−
,, McL. ..	∓	Trace	−	−	−	−
,, C.	∓	∓	Trace	−	−	−

* A chronic carrier of paratyphoid A; the remainder temporary carriers.

These reactions were estimated on arrival at the depot. All these men had been recently inoculated against enteric fever.

During the five years 1906-1911 that the writer was engaged in work on enteric fever in India, only two fatal cases came under notice out of several hundred cases of paratyphoid fever. During the four years that the depot has been in existence, thirty carriers of bacilli of the typhoid group have been detected, and of these twenty at least might be classed as true chronic carriers. The remainder, had they been kept in hospital for at least two months from the cessation of their fever, would not have been a danger to their comrades; but as most of these men had had mild attacks of paratyphoid fever they would have been returned to barracks as soon as they were physically fit.

It may be asked, is the detection and removal of these men sufficient justification for the establishment and upkeep of the depots? The answer is undoubtedly in the affirmative. Two instances have been given in which acute carriers of the *B. paratyphosus* A gave rise to small epidemics of the disease, one man causing nine cases, the other twelve. Both these men ceased to excrete the bacillus spontaneously within a few weeks.

Had the twenty chronic carriers been allowed to remain in barracks or in camp they might quite readily have caused collectively one hundred fresh cases a year, and they would have been continually operative year after year. This calculation is based on the very moderate estimate that each carrier would cause only five fresh cases per annum, whereas one single carrier may give rise directly or indirectly to an epidemic of a hundred or more cases.

The detection of these men is a comparatively easy task,

provided that the work is in the hands of a trained worker and that there are not too many cases to deal with. To look for a carrier among a large garrison population, the majority of whom are inoculated, is one of the most difficult tasks imaginable. As a rule, one can only surmise the presence of such a person as evidenced from time to time by the appearance of fresh cases of fever. Carriers must be eliminated by the examination of all cases of fever.

The main work of the depots is not merely the detection of carriers, but lies rather in the examination of the great body of convalescents and their return to duty with a clean bill of health.

Without doubt the most dangerous person to have in an expeditionary force is the carrier, as under active service conditions his opportunities are greatest. It would be quite impossible to examine and to declare free from infection an expeditionary force of even fifty thousand men.

During peace we must prepare for war, and this is true as much of the detection of carriers as it is of the practice of musketry, &c. It must be remembered, however, that in war-time our forces may be operating in a country where enteric fever is endemic, and here we must fall back on our second line of defence, namely, protective inoculation.

Our armies of the future should be carrier-free, and at the same time protected against infection from without by inoculation. Even these precautions will not entirely exclude enteric fever, and therefore rapid and accurate diagnosis of fever on active service is essential, with the isolation of all cases of enteric fever. No man who has had enteric fever should be permitted to rejoin his unit until a thorough examination of his excreta has shown him to be non-infective. If such an examination is not possible, then the man should not be allowed to rejoin his unit while they are on active service. Better to lose the services of a few men than to run the risk of losing battalions.

To sum up, then, enteric fever in military service is caused by the presence in barracks or in camp of infected persons. The prevention lies in their detection and removal. How this has been accomplished in India it has been the purpose of this essay to show.

Note.—This paper was written in 1911-12.

A REPORT ON A BACTERIOLOGICAL INVESTIGATION OF TYPHUS FEVER DURING THE SERBIAN EPIDEMIC OF 1915.

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The following investigations were carried out in the bacteriological laboratory attached to the British Military Sanitary Expedition to the Serbian forces.

The laboratory was established at Kragujevatz at the end of March, 1915. The material examined was obtained from the 6th and 7th Reserve Hospitals in that town. In all, some thirty cases of typhus fever were submitted to examination.

Examination of Stained Specimens of Blood.

Twenty-two cases of typhus fever were examined in this way. The great majority of these were cases in the second week of the disease, with the rash well out and with the temperature fluctuating between 102° and 104° F. A few were febrile cases in which a provisional diagnosis of typhus had been made, but in which no rash had yet appeared. These cases were examined in order to determine whether any difference existed in specimens of blood taken during the first few days of the disease.

The exact method of procedure was as follows. In all cases where a rash was present the skin over a typical typhus spot was cleansed with ether, and the epidermis scarified with a needle. Blood and serum were then made to exude; in some cases by pressure, and in others by suction by means of a small improvised suction cup. Specimens were prepared from this blood-stained serum in the following ways: In all cases one or more thick drops were taken on an ordinary slide and allowed to dry. These were subsequently hæmolysed in one per cent acetic acid, and stained by Leishman's method and also with dilute methylene-blue. In a large number of cases negative films were prepared by mixing the blood and serum with Chinese ink. In several cases ordinary spread films were also prepared and stained with Leishman's stain. In many instances ordinary blood films were obtained from some other part of the body, usually from the ear or the finger, and stained by Leishman's method.

[1] Late Temporary Captain, Royal Army Medical Corps.

The blood films showed the usual leucocytosis and the high percentage of large mononuclear cells which have been observed by previous investigators. In addition to this, films from several cases showed the presence of a small proportion of polychromatophilic red cells.

In the majority of the thick-drop preparations a varying number of micro-organisms were present. In a few cases these consisted of cocci or short bacilli, but by far the most common and most constant organism was a long bacillus of the *Bacillus fusiformis* type, sometimes approximating closely to a spirillum in form. This was so frequently present that it was deemed advisable to examine control specimens from non-typhus cases.

The examination of films prepared in an exactly similar manner from eleven Serbian soldiers, suffering from gunshot and other wounds, showed this organism to be present in ten out of the eleven cases. It seemed, therefore, that it was impossible to sufficiently free the skin from micro-organisms for preparations of this type to be of value, and this method of examination was discontinued. No appearances suggesting the presence of protozoal organisms were seen.

As a point of interest it may be noted, that, in the examination of these specimens and of similar preparations from undiagnosed febrile cases, which later ran the course of a typical attack of typhus, the occurrence of a double infection with the spirillum of relapsing fever was established with some frequency.

Cultural Examination of the Blood.

Cultures were prepared from the blood in eight cases of typhus fever. The exact day of the disease on which the cultures were taken was impossible to determine since the date of onset was unknown. Each of these cases, however, was a clinically typical case with a well-marked rash, and in seven out of the eight with a temperature fluctuating between 102° and 104° F. In the remaining patient the temperature was subnormal. This was a particularly severe and acute case leading to a fatal termination in the early part of the second week, a few days after the appearance of the rash, and the blood was obtained within a few hours of death.

It may be said, however, that in all cases the cultures were taken during the second week of the disease and during the days preceding the termination of the attack by the customary rapid lysis or by death. As a matter of fact, the majority of the cases

examined in this way proved to be of a severe type and ended fatally.

The blood was obtained in all cases from the median basilic vein of the forearm. The skin over the vein was cleansed by swabbing with ether and then painting with a two per cent solution of iodine in spirit. In two cases the preliminary cleansing with ether was omitted.

A considerable number of cultures were prepared from each case. The methods employed were as follows:—

(1) *Broth.*—Aerobically and anaerobically. About one cubic centimetre of blood was added to ten cubic centimetres of ordinary broth prepared from bullock's heart and containing 0·5 per cent sodium chloride and one per cent peptone. The broth was standardized to +6 acidity on Eyre's scale, and this reaction was employed in all cases. The anaerobic cultures were put up in ordinary Buchner tubes and were not employed in all cases.

(2) *Agar.*—Aerobically and anaerobically. 0·5 cubic centimetre of blood was spread on an ordinary agar slope.

(3) *Blood Agar.*—In some cases the same procedure was carried out using agar slopes which had first been spread over with normal human blood.

(4) *Ascitic Fluid Broth.*—Aerobically and anaerobically. In a few cases 0·5 cubic centimetre of blood was added to tubes containing a mixture of two parts of broth and one part of sterile ascitic fluid.

(5) *Kidney Tissue-Ascitic Fluid Agar* (Method of Noguchi).—This was employed in all cases, about one cubic centimetre of blood being used. In five out of the eight cases the kidney tissue was obtained from rabbits, and in the remaining three from a young kitten. The cultures were covered by a layer of sterile paraffin. Controls of the ascitic fluid and kidney tissue were put up in all cases.

It is convenient to deal first with the kidney tissue-ascitic fluid agar cultures.

In two cases these remained sterile. In three cases the cultures remained apparently sterile for fourteen days. During this time, however, a gradual opacity developed in the cultures. This did not seem to be wholly explained by autolytic changes in the added blood, since a set of cultures which had been prepared in the same way from a case of relapsing fever did not show the change to anything like the same degree. At the end of the fourteen days a thin cylinder of the medium, penetrating the whole length of the culture, was removed from each tube by means

of a sterile capillary pipette and added to a tube of broth. At the same time a similar cylinder was removed from a control tube containing kidney tissue and ascitic fluid agar, but no typhus blood. All the broth tubes were then incubated. On the following day each of the three tubes, which had received material from the typhus cultures, showed a uniform cloudiness of the broth, while the broth in the control tube remained perfectly clear. This cloudiness increased on the second day and a flocculent deposit began to form at the bottom of the tube. This continued to increase in bulk while the supernatant fluid gradually cleared.

Films prepared from this deposit and stained by Gram's method or by methylene-blue showed nothing. Ordinary wet films, however, showed minute particles which suggested minute coccal or bacillary organisms. After prolonged trials, it was found that these bodies could be stained, though with difficulty, by the use of a two per cent watery solution of eosin applied for twenty minutes or longer. They then had the appearance of minute coccal or bacillary organisms when they could be separated from the large clumps in which they always occurred. These clumps themselves had an almost structureless, but obviously granular, appearance. The gradual increase in the turbidity of the medium and the formation of the plentiful flocculent deposit strongly suggested the presence of bacterial growth, while the broth in the control tube remained permanently clear, nor could any similar appearances be demonstrated in stained films prepared from it.

The experiment was repeated with a second series of broth tubes from the same cultures with identical results. All attempts to make the small organism grow on further subculture failed. In three cases cultures prepared in this way showed the presence of the cocci to be described later, and on subculturing into broth in the way described above cultures were obtained within twenty-four hours containing these cocci and also the minute pleomorphic forms.

Turning now to the broth cultures and ascitic fluid broth cultures, in every case a growth was obtained of a Gram-positive diplococcal organism. The character of the growth obtained in broth upon isolation from the body was in all cases similar. The broth above the deposit of blood was slightly cloudy, while a flocculent deposit appeared just above the blood layer and also clinging to the sides of the tube, the whole resembling the growth obtained with many streptococci. The broth just above the deposited blood was in many cases strongly tinged with hæmoglobin.

This characteristic form of growth, however, seldom persists in subculture. Growth usually first showed itself on the second day of incubation, but sometimes earlier. The organism showed a marked preference for aerobic conditions, although a slight growth was always obtained in the anaerobic tubes.

Morphologically the organism is a diplococcus, sometimes arranged in clumps, sometimes in short chains. In some cultures, and under conditions which it has up to the present been impossible to determine, it takes on an ovoid form resembling a very short stumpy bacillus. The central part of the coccus sometimes stains more lightly than the periphery. The organism in its typical coccal or ovoid form stains easily and is Gram-positive. It grows well on all ordinary media, but much better under aerobic than under anaerobic conditions. Its growth has been tested on agar gelatine (which is slowly liquefied by seven out of the eight specimens), potato, blood agar, blood serum, Dorset's egg medium, Besredka's medium, McConkey's medium, Conradi and Drigalski's medium, and in various special ways.

On agar the growth resembles rather that of a bacillus or streptococcus than that of a staphylococcus. It is somewhat translucent and has a greyish-blue tinge by transmitted light, though this typical type of growth is sometimes departed from in subculture for no obvious reason.

On McConkey's medium the growth is very slight and almost invisible to the naked eye. On Conradi and Drigalski's medium the organism grows very poorly. The colonies are at first a grey-white colour, but later take on a pinkish tinge with a corresponding discoloration of the medium.

One of the most striking characteristics, however, on all classes of media, but on some more than on others, is the appearance of forms departing widely from the original diplococcal type. If a broth culture of the organism be examined daily by making film preparations and staining them by Gram's method, using the two per cent eosin solution as a counter-stain, it will be found that within about twenty-four hours a certain number of organisms, retaining the diplococcal form but somewhat smaller than the original cocci, are present, which fail to stain by Gram's method. These Gram-negative organisms rapidly increase in number and as they do so become smaller and lose the typical coccal shape. At this stage one of the most common forms is an elongated coccus arranged in pairs and somewhat resembling the pneumococcus in shape, but of a considerably smaller size. The change progresses

and the involution forms become smaller and smaller in size and less distinct in outline. Minute coccal and minute bacillary forms are present; until, finally, a large proportion of the deposit at the bottom of the broth tube seems to consist of non-Gram-staining granular material arranged in clumps, and in which little structure can be made out with a one-twelfth oil-immersion lens.

As stated above, these small forms fail to stain by Gram's method. They equally fail to stain with such dyes as carbol-thionin or methylene-blue. They stain faintly with carbol-fuchsin and rather better with aniline gentian violet without subsequent decolorization, but the best method of staining is with the concentrated eosin solution mentioned above. These forms are, in fact, identical with the small cocco-bacillary organisms and the granular material described in the case of the Noguchi cultures.

A large number of experiments have been performed in order to determine whether these minute bodies are degeneration forms or whether they represent some active phase in the life-history of the organism. This is a question of some importance in view of the recent work of Hort and Ingram.

Of considerable interest are the results obtained by noting the changes which occur when saline suspensions of the Gram-positive diplococci are maintained at temperatures of 37° C. and 0° C. respectively.[1]

In the saline suspensions which are maintained at a temperature of 37° C., the change into the minute Gram-negative organisms takes place with great rapidity. It is well marked within twenty-four hours and almost fully developed before the third or fourth day. By this time the great majority of the organisms present consist of these minute forms. It should be noted that neither in this nor in any other case do the Gram-positive cocci ever completely disappear.

The one difference exhibited between the appearances in the saline suspensions and those obtained in broth cultures is that the large granular masses which develop in the latter are seldom or never seen in the former.

In the saline suspension kept at 0° C., on the other hand, the change is almost completely inhibited. As mentioned above the development of the minute Gram-negative forms is almost complete within a few days at 37° C. In suspensions kept for one month in

[1] I am indebted to Dr. L. S. Dudgeon for suggesting the examination of the behaviour of this organism in saline suspension.

the ice-chest only a small proportion of these forms are found, and if the suspensions are examined daily during this period only a very slight increase in the relative proportion of the small organisms is observed. All saline suspensions of the coccus seem to contain a certain number of them.

The saline suspensions which have been kept in the ice-chest and those which have been kept in the incubator show obvious differences macroscopically. The iced specimens remain cloudy for many days and only gradually clear as the bacteria are deposited in a thick sediment at the bottom of the tube. The saline suspensions which are kept at body temperature gradually become clearer without the formation of more than a trace of deposit.

In further experiments the effect was studied of allowing saline suspensions, which had previously been heated to 60° C. for thirty minutes, to incubate at 37° C. over a period of several days. Specimens of the same suspension which had not been subjected to the preliminary heating were used as controls. The results showed that suspensions of dead organisms do not undergo the alteration noted above, or at all events they undergo it only in a minimal degree. After the preliminary heating a proportion of the cocci fail to retain the gentian violet when stained by Gram's method, and a few small forms are usually found. But, at a later period, when the control suspension shows the alteration to be fully developed, no appreciable change can be noted in the killed organisms.

The rate of change occurring on different media and under different conditions has been noted in a large number of cases. In general, it may be stated that the small Gram-negative forms appear more rapidly on all media under anaerobic than under aerobic conditions. They appear somewhat more readily on blood agar than on ordinary agar. On blood serum they develop slowly. On potato at about the same rate as on agar. The difference between aerobic and anaerobic cultures and the rapidity of the change in saline suspensions would suggest that these forms tend to appear more readily when the organism is growing under unfavourable conditions. This is, however, by no means always the case. Thus, on McConkey's medium, or on the medium of Conradi and Drigalski, growth is very poor, but the small Gram-negative forms practically never appear. The most noteworthy feature displayed by the organism growing on these two media is the very great variation in size and shape of the Gram-positive coccal forms. Some are large and swollen and often ovoid rather

than spherical in shape, others being considerably smaller than normal.

Again, an attempt was made to determine what alteration in form occurred in this organism when it was grown on media possessing varying degrees of acidity or alkalinity. This was done partly in order to determine whether the Gram-positive cocci ever took on a definite bacillary shape, for reasons that will appear when the results obtained by other workers are considered.

In these experiments the organism was grown on an agar medium the reaction of which varied in different tubes from −30 to +30 on Eyre's scale. At both extremes of reaction the growth was very poor, but on the −30 agar none of the small forms developed, though the organism was obviously growing under very unfavourable circumstances. Moreover, it sometimes happened that in growths on agar slopes, possessing the usual reaction, the formation of minute Gram-negative forms occurred with extraordinary rapidity, so that they considerably outnumbered the normal Gram-positive forms on the second or third day, although the growth was copious and of typical naked-eye appearance.

Attempts to demonstrate the further growth or development of these small forms on subculture have so far failed. After the saline suspensions have been allowed to remain in the incubator over periods varying between ten and twenty-one days, they are found to be sterile on subculture on ordinary media, such as nutrient broth or agar. At this period film preparations show abundance of the minute forms and a small proportion of Gram-positive diplococci. Suspensions of this kind have been subcultured in a large variety of media and under aerobic and anaerobic conditions, but it has not been found possible to obtain any multiplication of the small forms. In a few cases, in which no growth occurred in broth or on agar, a growth of the Gram-positive diplococcus was obtained in tubes containing a mixture of one per cent glucose agar and ascitic fluid. Further experiments along these lines are being carried out.

In addition to the organism described above, a bacillus was isolated in two cases on blood agar, once aerobically and once anaerobically. In early cultures it appeared as a short Gram-positive bacillus, later it became longer and at the same time lost its Gram-staining. In old cultures long thread-like forms appeared and the organism became highly pleomorphic, large numbers of coccal forms putting in an appearance. These latter were Gram-positive. As this organism was only isolated on two occasions,

and as moreover it has never been possible to demonstrate the appearance of similar forms in the diplococcal cultures, it seems possible that it was an accidental contamination.

Cultural Examination of the Cerebro-spinal Fluid.

Two cases were examined in this way. One of these exhibited no meningeal symptoms ; the cerebro-spinal fluid appeared perfectly normal and cultures remained sterile.

In the second case definite meningeal symptoms were present. The cerebro-spinal fluid contained a few polymorphonuclear leucocytes, though it appeared perfectly clear to the naked eye. Cultures from this fluid on human blood agar yielded on the second day a growth of the coccus described above. This organism behaved in exactly the same manner as those isolated from the blood. After several days small Gram-negative bacilli with rounded ends and with a tendency to polar staining appeared in these cultures. It was found impossible to separate the cocci and bacilli by subculture. In subcultures on ordinary agar the coccus alone developed in most cases. In stab agar or in broth cultures both forms were usually present, but the bacillus could never be obtained alone.

Cultural Examination of the Urine.

Great stress has been laid on the examination of the urine in typhus cases in recent papers by Hort and Ingram. The conditions existing during this epidemic rendered it extremely difficult to obtain sterile catheter specimens for examination, and for this reason such examinations were not undertaken.

The Relation of these Findings to those Obtained by Other Investigators.

Only cultural results are here considered.

Since the method of obtaining cultures from considerable quantities of blood drawn from a large vein has come into vogue, a considerable number of investigators have isolated from typhus cases organisms of a coccal or cocco-bacillary form.

Wilson in 1910 obtained Gram-positive diplococci in fifteen out of thirty-three cases of typhus fever. The description which he gives of this organism, particularly as regards its growth on agar and the liquefaction of gelatine, which occurred in about half his cases, agrees rather closely with the organism described above. He makes no mention, however, of the occurrence of the minute Gram-negative form.

In one case he isolated a Gram-positive diplobacillus.

By means of agglutination reactions he demonstrated the presence of specific antibodies in the blood of typhus patients against this organism. He was inclined to believe, however, as the result of various considerations, that these organisms represented rather a secondary infection than the actual cause of the disease.

In a few cases the organisms isolated during the present investigation were tested against the serum of typhus patients and against that obtained from normal controls, but it was found that the cocci had a strong tendency to spontaneous agglutination, and that the degree of agglutination was greatly increased by the presence of normal serum, and for this reason no further tests of this kind were made.

Rabinowitsch in 1909, during an epidemic of typhus in Kieff, isolated from the blood of patients suffering from this disease a short bacillus with rounded ends and showing some degree of polar staining. These organisms grew well in broth but poorly on solid media during the early subcultures. The bacilli tended to occur in pairs lying end to end, and on some media they showed marked changes in their morphological characteristics, assuming a more ovoid form. It was necessary to take the blood between the sixth and fourteenth day of the disease. Rabinowitsch demonstrated a certain degree of agglutinating power against these organisms in the blood serum of typhus patients, though the results do not seem to have been constant.

Predtjetschensky in 1910, during an epidemic of typhus in Moscow, isolated from every case examined between the sixth and ninth day of the disease a short bacillus showing polar staining. This bacillus took on varying forms according to the culture medium on which it was grown. On agar it usually showed a diplococcal form, in broth it grew as a bacillus. It readily produced involution forms, such as ovoid forms with pointed ends and sometimes long thread forms. The bacillus was Gram-negative Gelatine was not liquefied. Agglutination reactions gave no certain results. This organism was also isolated in a few cases from the sputum of typhus patients with bronchial catarrh.

Fuerth in 1911, during an epidemic of typhus fever in Tsingtau, isolated from the blood in sixteen out of forty-two cases a very similar organism. In broth cultures it grew as a very short bacillus, mostly single, sometimes double and sometimes in short chains. At first it was Gram-positive but later tended to become Gram-negative. A large number of coccal forms were present.

After growing for a few days in broth, these organisms tended to disappear and to be replaced by small granular organisms which gave the impression of degenerating bacteria. The organism grew well on most media but best on ascitic fluid broth, as was the case also with the organism described by Rabinowitsch. Agglutination reactions were inconclusive.

Müller in 1913 isolated from the blood of five out of eleven typhus patients organisms very similar to those described above. He emphasizes the highly pleomorphic character of the bacteria, and states that they sometimes take on an almost purely coccal form when they are arranged as diplococci or in short chains. In broth there was a tendency to the formation of peculiar degeneration forms, drum-stick and dumb-bell forms and irregular masses. These were at first Gram-positive but tended to become Gram-negative. Gelatine was not liquefied.

Hort and Ingram in 1914 examined the blood in twenty-two cases of typhus fever occurring in Ireland, and state that they obtained without difficulty cultures of the diplococcal and diplobacillary organisms described above. As these organisms did not in their hands produce any observable pathogenic effect in a series of bonnet monkeys, they concluded that they were either secondary infections or harmless phases in the life-history of some previously undescribed organism. Upon examining the urine obtained from thirty cases they found during the period of fever large numbers of the diplococci and diplobacilli described above. They also noted in fresh specimens of urine the presence of minute organisms which occurred singly or in pairs or in clusters. They were sometimes coccal in form, sometimes bacillary, and it was often impossible to determine whether they were coccal or bacillary. They were both Gram-positive and Gram-negative in the same clusters. They rapidly disappeared when the urine was incubated and after a few hours only the large cocco-bacillary forms could be found. After filtration of the urine through Berkefeld candles the small cocco-bacillary forms were obtained alone. When, however, this filtrate was incubated these forms quickly disappeared, their place being taken by the larger coccal and bacillary organisms. Similar findings were obtained in the urine obtained from bonnet monkeys successfully inoculated with human typhus blood. By inoculation of human blood agar with the fresh filtrate of human typhus urine, cultures of the small organism were obtained, which on subculture became mixed with the larger forms. Injection of the first culture on human blood agar into two bonnet monkeys gave rise to a high

continued fever after the lapse of a definite incubation period of a few days. This small organism was also found to be present in the cerebro-spinal fluid of typhus cases, but on incubation it was soon replaced by the large cocco-bacillary form. From fresh human typhus blood and from fresh cerebro-spinal fluid the small cocco-bacillus could be cultivated on human blood agar. (It is not stated whether these cultures were pure.)

Silberberg, in 1912, found a micrococcus in the cerebro-spinal fluid of typhus patients. This was marked by its pleomorphous character and by the fact that it constantly showed a light-staining middle part.

It must be noted that a large number of investigators have failed to obtain any growth in cultures obtained from typhus blood.

It is obvious that these investigations have led to the isolation of organisms possessing striking similarities. The question of the specific relation of any or all of them to typhus fever cannot be said to have been determined, but the results show that organisms of a similar type have been isolated from outbreaks occurring in different parts of the world which have been studied by different observers. Whether the organisms represent a harmless phase in the life-history of a highly changeable organism, as suggested by Hort and Ingram, is a question which needs further investigation.

It would seem probable at least that the small organisms which they describe are identical with those obtained during the course of the present investigation, though a point of difference occurs in the Gram-staining. Hort and Ingram's small cocco-bacilli are stated to be both Gram-positive and Gram-negative, while those isolated during the present investigation were almost entirely Gram-negative, and indeed were extremely difficult to stain at all, though it is true that in some cases, where the change from the large to the small organisms had not proceeded far, forms staining faintly with the gentian violet were obtained. It seems probable too, that both these small organisms are related to the so-called degeneration forms of Fuerth, of Predtjetschensky, and of Müller. Whether these small organisms are in truth degeneration forms can only be determined by further investigation. Their mode of appearance, their rapid production in saline solution, and the great difficulty experienced in their staining, would seem to support this view. Moreover, all attempts to subcultivate them have failed, so far as the present investigation is concerned. On the other hand, the results obtained with the Noguchi cultures seem definitely to show

that under certain circumstances they are capable of multiplication and growth. The results obtained by Hort and Ingram would tend to support the view that they are special forms of the organism rather than the result of degeneration, if we may assume the identity of the two organisms.

The recent publications of Plotz, both alone and in conjunction with Olitsky and Baehr, have introduced an entirely new factor into the bacteriological study of typhus fever. As the result of these investigations a very strong case is made out for the causal relationship towards this disease of a small Gram-positive bacillus, which is a strict anaerobe, though in Plotz's earlier communication it was stated that the organism would grow aerobically on subculture. The organism is stated to be a small pleomorphic Gram-positive bacillus, and coccal forms are said to be of fairly frequent occurrence, while polar staining sometimes occurs. It will be seen that the morphological characteristics of this organism bear several striking resemblances to those described by the investigators whose results have been noted above; but, in view of its marked peculiarities as regards cultivation, it seems most unlikely that it bears any relation to the organisms which have been previously described. Plotz himself is especially emphatic on this point. It must however be noted that Plotz only studied eight cases of epidemic typhus fever, from all of which, however, the bacillus was isolated. The majority of his observations were made on cases of the endemic febrile disease occurring in certain parts of the United States, which Brill had shown to be identical with mild cases of European typhus. The isolation of this organism from monkeys inoculated with typhus blood, and the large series of complement-fixation tests, which Plotz and his co-workers have carried out, must be regarded as pointing strongly to this organism as the causative factor in the disease.

In three cases Plotz isolated this organism by the use of Noguchi's method of cultivation. In all the eight cases studied in the present investigation, the blood was cultivated by this method, without ever obtaining a growth of the organism described by him. Too much stress should not, however, be laid on this point, since Plotz found that a medium consisting of glucose agar and ascitic fluid was far more favourable, and since his method of cultivation had not then been published, this medium was not employed. Moreover, the very varying suitability of different specimens of ascitic fluid for cultivations of this type is well known.

It is, of course, possible that Plotz's organism represents a phase

in the life-history of some exceptionally pleomorphic bacterium, but no organism presenting such very varied characteristics is yet known.

Experiments are being carried out in order to test such a possibility, and also to determine the pathogenicity for laboratory animals of the organism isolated in the course of the present investigation.

I should wish to express my appreciation to Colonel Hunter, A.M.S., and to Lieutenant-Colonel Stammers, R.A.M.C., for the kindly interest which they showed throughout this investigation.

I am greatly indebted to Colonel Gentitch and to Majors Protitch and Antitch of the Serbian Medical Service, for their kindness in supplying me with various materials for use in my laboratory, also to Captain Copshje, in charge of the 6th and 7th Reserve Hospitals at Kragujevatz, for permission to obtain material from the cases under his charge, to the doctors of the Scottish Women's Hospital who formed the staff of these two institutions, and to various officers of our party who assisted me in obtaining specimens for examination. Especially am I indebted for his invaluable help to Lieutenant McCall Smith, who acted throughout as my assistant.

I must also thank Drs. Rosher and Platts, my assistants at Charing Cross Hospital, for the help which they have given me since my return.

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Clinical and other Notes.

A NOTE ON CAMP SANITATION.

By Major A. H. SAFFORD.
Royal Army Medical Corps.

The following simple methods of preventing fly infection from latrines which have been adopted, but which do not seem to be in general use, may be of assistance to officers of the Corps.

(1) Destruction of fouled paper in latrine pans and shallow trenches. The sanitary orderlies go round the latrines with a box of matches and set a light to the paper in each pan or shallow trench three times daily at 9 a.m., 2 p.m. and 6 p.m. It has the following advantages: (*a*) The fæcal matter on the paper is destroyed and consequently cannot infect flies; (*b*) the bulk of material in the pan is considerably reduced; (*c*) the sides of the pan are sterilized; (*d*) fouled paper is not blown about the camp. There is no danger of setting light to the latrine seat.

(2) One gallon cresol solution (quarter ounce to the gallon) is used in each latrine pan. This strength is sufficient to repel the fly, and any stronger solution is therefore unnecessary, as whatever strength is used the fæcal mass will not be sterilized. If less solution is used the fæcal mass will rise above the surface of the fluid and be exposed instead of the fluid rising above the fæces.

If these two methods are combined, there is no possibility of fly infection from the latrines.

BLOOD CULTURES *V.* CLINICAL DIAGNOSIS.

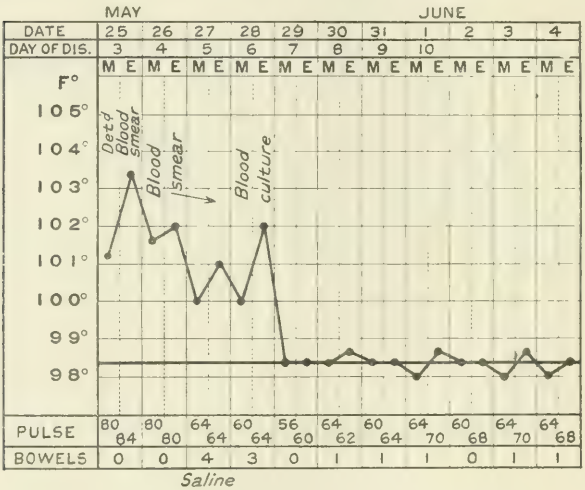
By Lieutenant-Colonel F. C. HEFFERNAN
and
Major F. A. H. CLARKE.
Royal Army Medical Corps.

Private R., belonging to a Territorial Infantry unit in Mhow, and recently returned from a visit to Delhi and Agra, was admitted to hospital, having been detained on the previous day. He complained of headache of three days' duration, pain, exaggerated on movement, in the eyeballs, a dull aching pain in the loins, and pains in the knee-joints. There was slight constipation, tongue thinly furred, eyes injected, and face flushed. Temperature on admission 101·8° F., pulse 80. Respiratory and circulatory systems normal, and no abdominal pain nor distension. Blood smears examined for malaria were negative on two occasions.

The treatment was mainly symptomatic, and the symptoms cleared up

on the day after admission, when the temperature fell to 100° F. and a papular rash appeared on the chest. The next day the temperature rose in the evening to 102° F., falling to normal by crisis the following morning and remaining so.

Convalescence was uninterrupted, and the patient was, to all intents and purposes, well and fit for duty within a week. A blood culture taken on the third day in hospital had in the meanwhile, on examination in the Divisional Laboratory, given the reactions of paratyphoid A, and these were subsequently confirmed at the Enteric Convalescent Depot at Naini Tal.



From a glance at the temperature chart it will be seen that it is a typical one of dengue, and the symptoms were characteristic of that disease in a mild form. There was an entire absence of anything that would direct one's attention to the abdomen, the patient had been fully inoculated six months previously, and the case, up to the time of receipt of the laboratory report, was believed to be one of dengue. The blood culture was made only because it is a routine measure in this station, and not because the case was regarded at any time as suspicious.

Our apology for reporting this trivial case lies in the fact that, in the absence of a positive finding in the blood, this man would have been at his duty within ten days of his last day of fever. The potentialities of cases similar to this, as a possible cause of the spread of disease, cannot

be overstated, and for this reason it is urged that the fullest advantage should be taken by medical officers of the facilities which exist for the examination of blood cultures in a laboratory.

We are indebted to Captain P. Hayes, R.A.M.C., in whose care the case was, for kindly giving us the clinical details.

CASE OF SIMULTANEOUS BILATERAL FRACTURE OF PATELLÆ BY MUSCULAR TRACTION.

By Temporary Lieutenant J. ANDERSON, M.B., Ch.B.
Royal Army Medical Corps.

As this case is unique the following particulars are given :—

Driver J. C. A., aged 31, was admitted to the Connaught Hospital, Aldershot, on June 20, 1915, with obvious fracture of both patellæ. He stated he was practising for regimental sports, and that at the time of the accident he was engaged in "hop, step and leap." At the "hop" he stepped off on his right foot and as he landed he felt the right knee-cap give way. At the moment the left foot touched the ground the left patella also gave. At the time the accident occurred he heard "two cracks," one immediately after the other, and the sound he likened to the breaking of pieces of "dry wood." This occurred before either knee touched the ground. The soil was soft sand, and there were no stones to fall on as the track had been specially prepared. He had no pain immediately after the accident, but could not rise from the ground.

The clinical picture was the usual one found in such a condition, with considerable interval between the fragment. There is no family or previous history of bone disease, and patient is a healthy muscular man with large frame.

X-ray examination showed: *Left side*, simple transverse fracture. *Right side*, a three-fragment fracture.

Treatment.—Transverse wiring.

Unusual points which justify record :—

(1) Almost simultaneous bilateral fractures by indirect violence.

(2) On one side the fracture was multiple.

CASE OF LAMINECTOMY, LUMBAR REGION.

By Captain G. G. TABUTEAU.
Royal Army Medical Corps.

Patient, Private T., admitted to No. 1 Stationary Hospital, April 29, 1915, suffering from gunshot wound of back. There was a circular entry wound apparently caused by a shrapnel bullet, in the left loin above the posterior superior iliac spine. No exit wound. He had been wounded four days previously. Condition on admission: Temperature 100° F., pulse 88, respirations 20. Complete paralysis from the umbilicus

downwards. Plantar, patellar and inferior abdominal reflexes absent. Sense of touch and pain present and unaltered. Loss of function of bladder and rectum. Urine very strongly alkaline and containing much thick ropy pus. Bladder distended to umbilicus on admission. Urine contained much blood on withdrawal. Regular catheterization required. Bowels relieved by enemata. X-ray examination showed a full shrapnel bullet lying in the lumbar region just to the left of the mid-line, apparently between the fourth and fifth lumbar spines. The bullet was localized by MacKenzie Davidson's method. Urotropine, ten grains, administered four-hourly.

Operation, May 2, 1915.—Morphia quarter grain, with atropine one one-hundredth grain, was administered hypodermically one hour before operation. Anæsthetic used, ethyl chloride and ether. The lumbar muscles were fully infiltrated with adrenalin chloride and novocain. A vertical incision was made slightly to the left of the middle line, and the muscles separated from their attachments and retracted outwards. Owing to the free use of the adrenalin injection before the operation, hæmorrhage from the muscles was *nil*. The spinous processes of the fourth and fifth lumbar vertebræ were chiselled away, then the left lamina of the fourth vertebra was removed. On opening the spinal canal no hæmorrhage was found and the bullet was seen to be lying loose in the canal, from whence it was removed with ease. The wound was closed with catgut sutures through the lumbar fascia, and with silkworm gut sutures for the remainder. A drainage-tube was left in the lower angle of the wound reaching to the vertebra. Patient bore the operation very well. Owing to the use of morphia and the infiltration of the muscles with adrenalin and novocain, very little general anæsthetic was required. Patient complained of pain in the back during the night, which was relieved by hypodermic injections of morphia quarter grain. He was dressed daily. Tube removed on the fourth day. Stitches removed on the ninth day. The wound healed by primary union. Temperature and pulse normal. Bladder condition continued very troublesome. A soft rubber catheter was tied in on May 5, 1915, and the bladder washed out twice daily with boric lotion.

May 8, 1915.—Pus in urine much less. There is some slight return of power in the legs, chiefly in the left. Bowels still have to be relieved by enemata. Complains of pain down the right thigh and leg during the night, which required the administration of one-sixth grain of morphia.

May 11, 1915.—Movement of legs much the same. Still complains of pain.

May 18, 1915.—During the previous week patient's temperature has been ranging between 99° and 100° F. There is no definite cause to be seen. Movements of limbs very much improved.

May 25, 1915.—Patient passed urine naturally for the first time. Practically full muscular power of the legs now present, and does not

To illustrate "Case of Laminectomy, Lumbar Region,"
by Captain G. G. TABUTEAU, R.A.M.C.

complain of any pain. Legs are considerably wasted, probably partly from disuse and partly from the spinal injury.

May 27, 1915.—Patient allowed up in a chair.

May 30, 1915.—Patient now walking with assistance.

June 3, 1915.—Improvement continues. Had a slight rise of temperature the previous night. Bladder and urine normal.

June 6, 1915.—Patient transferred to England. Pulse, temperature, muscle power, and bladder and rectum normal.

I am indebted to Lieutenant W. F. Neil, R.A.M.C., for his assistance during the operation, and to Corporal F. Martin, R.A.M.C., for the skiagraphy of the case.

REGIMENTAL MEDICAL AID IN TRENCH WARFARE.

By Colonel W. W. PIKE, D.S.O.

This, at all times a very difficult subject, has become more so by the use of high explosive shells by the enemy.

(1) The position of the medical officer and aid post in trench warfare should be about half a mile back; the aid post should have good cover, when possible in the cellar of a building or in a well-constructed dug-out and near a communication trench leading up to the front trenches. (i) Slight cases can be *directed* to this aid post; (ii) more severe cases *brought* to it by stretcher-bearers after the first field dressing has been applied; (iii) the medical officer can be *sent for* if any extra severe cases occur.

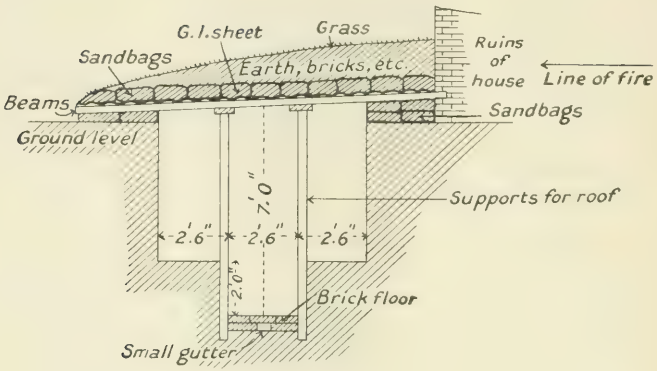
(2) The above position and conditions would be ideal, but are seldom obtainable.

The above was the introduction and the first two paragraphs of a circular sent out by me to all the medical officers in the Indian Corps, in which I asked for any suggestions officers would like to put forward. The response was very satisfactory, and I am particularly pleased at the clear opinions brought forward by many of the younger officers, showing that they have thought out and grasped the difficult problem which is the subject of this article.

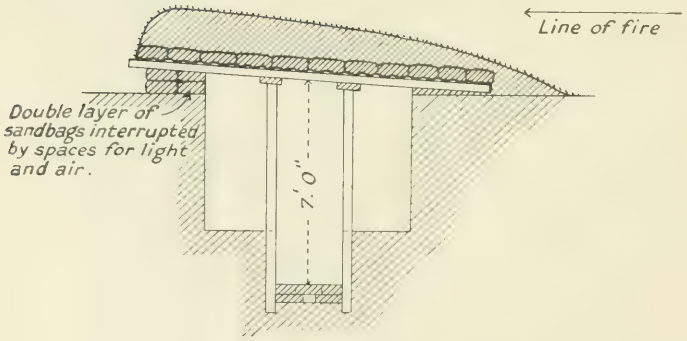
A consensus of opinion is in favour of the position above stated.

I will consider the subject under the following headings:—

(1) Position of aid post and medical officer.
(2) Equipment—(*a*) aid post, (*b*) medical officer, (*c*) stretcher-bearer.
(3) Personnel of aid post.
(4) Evacuation, to and from aid post.
(5) Forms and arrangement of the dug-out.
(6) Combined aid posts.
(7) Advanced dressing stations.

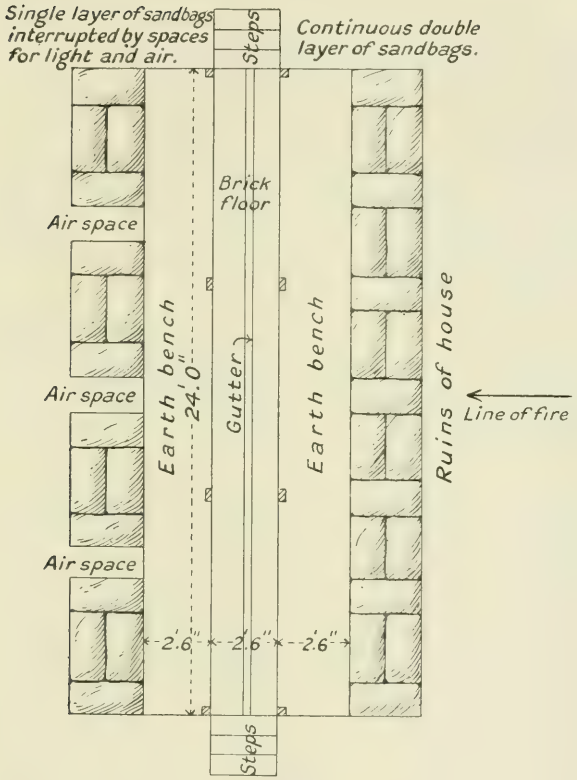


A.—End view.



C.—End view.

NOTE ON C.—If in the open the roof must slope this way, the edge next the enemy resting directly on the ground, and being well banked over with sandbags, bricks, and earth.



B.—Plan.

(1) Position of Aid Post.

This should be near the regimental headquarters, for the following reasons: (*a*) It is generally a good central position; (*b*) by being with the commanding officer the medical officer is at once informed of all important occurrences and he can act quickly; (*c*) he can be at once called by telephone to any part of the trench line should necessity arise; (*d*) he will be near the commencement of a communication trench; (*e*) he can do his daily sanitary inspections easily and fairly safely (his daily

visit has a good effect on the *moral* of the troops and the sanitary orderlies work better); (*f*) should he require more bearers, or a specially large number of cases require evacuating, he will be on the telephone to Brigade Headquarters, which should be connected up with the advanced dressing station; (*g*) *any* case can now be brought back through the communication trench on a "Rogers" trench stretcher, four of which (owing to the kindness of the committee of the "Indian Soldiers' Fund") I shall shortly be able to issue to every regiment in the Indian Corps; (*h*) the "carry" for the regimental stretcher-bearers would be short and (owing to arrangements *re* personnel, to be mentioned later) they should not go in the rear of the aid post; (*i*) in trench warfare one aid post is sufficient per unit, and often one is sufficient for two or more units (*see* combined aid posts).

(2) Equipment.

(*a*) *Aid Post.*—This contains a pair of panniers and a water-bottle, with either a field companion or surgical haversack, and a supply of shell dressings, also iodine and ampoules of ammonia for gas poisoning, means for heating water, milk, or beef-tea, and half-a-dozen blankets.

(*b*) *Medical Officer* should have his pocket case, iodine, morphine, and a few extra first field dressings in his haversack.

(*c*) *The Stretcher-bearers* should each have six first field dressings, a couple of shell dressings, and a small bottle of iodine with brush in a haversack. The non-commissioned officer or senior bearer carries the field companion or surgical haversack (whichever is not left at the aid post). Iodine should be applied to *all* wounds. One officer suggested that each bearer should have a pair of scissors for cutting off clothes, but this should be done *very* rarely, as cold adds to shock, and when necessary the pocket knife is just as handy. Medical officers and stretcher-bearers should invariably use the patient's first field dressing when suitable first, as in the majority of cases I have seen the wound has been dressed with dressings from the surgical haversack or field companion or the stock carried by the stretcher-bearers; the patient's first field dressing being in his pocket is forgotten. This is sheer waste which it is most important to avoid.

The medical officer must, by careful study of the trench map, know the exact lie and all about the trenches of his unit, and the troops must accurately know where the aid post is and its position with relation to the communication trenches.

(3) Personnel of Aid Post.

A medical officer, assistant or sub-assistant surgeon (or non-commissioned officer in British formations), orderlies, ward servants, etc.; *each aid post should have four to six bearers, with two stretchers, attached to it from the advanced dressing station* (*or more if a heavy engagement is expected*).

(4) Evacuation.

The case should be evacuated, by communication trench, to the aid post *as soon as possible* after being wounded either walking or carried on a "Rogers" trench stretcher by stretcher-bearers of the unit.

After being attended to by the medical officer, the case should be evacuated from the aid post *as soon as possible* to the advanced dressing station walking, or by ordinary or "Rogers" stretcher carried by bearers lent by the advanced dressing station. These bearers should return or be replaced at once and bring back the stretchers, or others in place of them.

Evacuation should go on at all times when possible; usually it can be carried out more safely by day than by night, and the stream from the fire trenches to the aid posts, advanced dressing stations, field ambulances, and on by motor ambulance convoys to casualty clearing stations should be constant. There will be stoppages owing to severe bombardments, hostile infantry attacks, etc., but then the movement must be re-started at the earliest possible moment.

We have a most excellent method in the Indian Corps of evacuation from aid posts to advanced dressing stations which I can show to any officer who wishes to see it, but which it would be inadvisable to publish in this article.

(5) Forms of Aid Post (*see* sketches, pp. 234, 235).

Houses when possible, but good cellars or dug-outs to go into if shelled, are indispensable. If there is no house standing, a dug-out close behind a ruined house is the most satisfactory, and the cellar may possibly be used also.

Dug-outs are of all kinds and shapes, and must of necessity vary greatly. One of the best, which is capable of sheltering (except from *direct* shell fire) thirty sitting cases or six lying on stretchers (or, of course, a proportion of each), requires the following dimensions, and should be dug the same shape as nearly as possible as the inside of an omnibus: width 7 ft. 6 in., depth 5 ft. to 7 ft.—the nearer the latter figure the better, as it is terribly fatiguing to work in a stooping position—length 24 ft., entrance 2 ft. 6 in. wide in the centre of one end, exit at the other by steps cut in the clay and not too steep. The seats should be 2 ft. 6 in. wide and the same height, the middle space the same width, *i.e.*, 2 ft. 6 in. It is advisable to lay boards (if available) or bricks on the floor. The roof should be made of beams supporting sheet iron covered with sandbags and earth to a depth of at least 2 ft. or more, and if bricks are put in as well all the better. The sheet iron should have enough slant not to lodge water. This may be effected by placing the side next the enemy on a double row of sandbags and the other side on an interrupted row of single sandbags—the interruptions allow air and a certain amount of light to enter at the side distant from the enemy. If not protected by the remains of a house

the higher side should be away from the enemy and the lower side, resting on the ground, "banked over" with sandbags and earth and covered with grass. Grass seeds might be planted on the top, or the whole might be turfed over.

The dug-out can be made any size, but the 24 ft. size seems best, and if more accommodation is needed a second can be made, which should communicate with the first. Other dug-outs should be made for the medical officer and personnel.

One medical officer, a Captain, of the Royal Army Medical Corps, has a special dug-out for detained men, and estimates that about seventy to eighty men were kept with the regiment monthly by this means who would otherwise have gone to hospital and been away a long time; this is a point worth considering.

All aid posts, whether dug-outs or houses, should be permanent and handed over on relief from unit to unit as *aid posts*.

(6) Combined Aid Posts.

In the present system of trench warfare it is usual for several regiments to hold a fairly short front, and the number of sites being limited an aid post is often formed with the medical personnel of several regiments in one place. This is, in my opinion, a most excellent plan; it enables medical officers (*a*) to relieve each other for rest; (*b*) to aid each other in operations; (*c*) to visit their front trenches and make sanitary inspections frequently and still have a medical officer in the aid post, as, of course, these visits and inspections should be made at different times, one medical officer being left at the aid post during the absence of the others. Under these circumstances one medical officer could be in the front trench for twelve hours at a time.

I am entirely in favour of these combined aid posts when at all possible, and there should be no chance of friction if separate dug-outs are used for the patients and personnel of units. Medical officers should share a dug-out.

(7) Advanced Dressing Stations.

These should be (*a*) in a fairly safe place, (*b*) a house if at all possible, with good dug-outs for use if shelled, (*c*) on a good road which is sufficiently under cover to allow of *constant* evacuation with a minimum of risk from shell fire, (*d*) in telephonic communication with Brigade and Divisional Headquarters, and so capable of telephoning to any aid post.

They should have, in addition to the usual drugs and equipment, oxygen and an apparatus for administering it, wheeled stretcher-carriers, spare stretchers, blankets, hot-water bottles, etc., and also one or more motor ambulance wagons, which as soon as filled start off for the field ambulances.

A FEW NOTES ON MILITARY RADIOGRAPHY IN THE ENGLISH HOSPITALS IN FRANCE, DURING THE FIRST NINE MONTHS OF THE WAR.

By CLAUDE GOULDESBROUGH, M.B.

Senior Consulting Radiographer to the British Expeditionary Force; Assistant Superintendent to the Electrical Department, St. Thomas's Hospital.

The following description and remarks refer not only to the numerous Royal Army Medical Corps hospitals proper, but also to the hospitals sent out by the various Voluntary Aid Associations, namely, the British Red Cross Society and the St. John's Ambulance Association, which, however, as regards control are under the direction of the Military Authorities.

The period under review naturally divides itself into two distinct parts, namely, the first four months (roughly), during which time, owing to the rapid changes in position of the combatants, hospital arrangements were necessarily of a temporary character, and the present period, dating from the establishment of two opposing lines stretching from the Channel coast to the Swiss boundary, during which time the hospitals have been able to be thoroughly organized at their respective bases. It must be understood that the field ambulances are not equipped with X-ray installations, but arrangements are being made to supply them with the assistance of radiography on the few occasions it is required.

From the end of August to the beginning of November a great number of wounded were being sent to Rouen and Paris, particularly the latter, as Rouen had not yet developed into the large hospital base it is at present. I was then in charge of the radiographic department at the British Red Cross Hospital at Paris (an auxiliary). I had brought with me from England my own portable outfit, and to this was presently added a permanent plant, the property of the British Red Cross Society. Owing to the fact that at first there were no other English X-ray machines out in Paris, the work was fairly strenuous, but by aid of a French assistant, M. Guy, and a very intelligent orderly, this hospital was relied on to do X-ray work not only for the other English and some French hospitals in Paris, but also for the places outside Paris as well, within a fair radius. For this purpose the portable apparatus was put in a car and taken where required, accompanied by one radiographer and orderly; meanwhile the other attended to the hospital proper. It must be stated that although the Gaiffe installation at the hospital was of the most perfect description, nevertheless the work which was done with the portable coil and thirty-six volt accumulators was just as good, if not better, than the work turned out at the hospital. This was of course due to the fact that one was working outside with an apparatus with which one was quite familiar, and points to the well-known fact that it is very difficult to produce at once perfect results when apparatus and tubes, etc., are new.

With the portable apparatus nearly every class of case could be satisfactorily dealt with from the radiographic point of view; but it was when it came to the question of screen examinations (hunting for the track of bullets, etc.), and accurate localization, that the want of the more elaborate installation was felt.

As a result of the work performed under these conditions it became evident that one of the most important factors in connection with military radiography was the possession of a portable outfit in connection with every installation, by which is meant the ability to be able to carry the apparatus to the bedside of those patients who are too ill to be moved, and it was surprising to find what a number of cases there were which could not be, or ought not to be, moved from their beds for this purpose.

Consequently later on, when it became necessary to advise concerning the radiographic arrangements at various places in France, one of the most important and difficult problems was the question of devising schemes to suit each individual requirement by means of which this necessity could be overcome.

During this first period, therefore, such radiographic work as was performed was done mainly by portable apparatus, the developing, etc., being carried out in tents, in which also the apparatus was kept. Now X-ray work under these conditions was extremely difficult to perform satisfactorily, owing to lack of proper facilities for washing, etc., to mention one factor only.

Certain deficiences in the existing standard War Office outfit, which could not have been foreseen, were also making themselves felt, the two main points being the difficulty of performing both a screen and a plate examination successively without disturbing the patient, and the septic nature of nearly all the wounds (which factor I gather from surgeons who were at the South African War had not been anticipated). As a consequence of this sepsis and the severity of some of the injuries, which it was impossible to have foreseen when the apparatus was devised, the result was that the radiographic table was in need of considerable modification. A third factor also was that the missiles, particularly bullets, were found to track considerable distances from their entry wounds, and consequently plates exposed in the vicinity of the seat of injury very frequently failed to reveal the foreign body. The most popular modern method of radiography for ordinary hospital and consulting practice has been to suspend the tube above the table, and placing the plate underneath the patient, to allow the rays to pass from above downwards. The advantages of this method, when practicable, are (1) quickness, (2) ease of manipulation, (3) almost complete protection against injury from the rays for the operator, and (4) less risk to the patient than when the damaged portion of body has first to be sought for and centred on the screen—the plate being subsequently substituted for the latter.

This method, however, for reasons already stated, proved impracticable, and so a new couch was devised, in which the tube was placed below the table, and the screen and plate-holder above, so that the rays passed first through the couch, then through the body before reaching the plate or screen. This is an old method revised.

The obvious disadvantages of this method, namely, risk of "burning," difficulty of rapid movement of tube, and unsteadiness of the plate, were minimized, in the first place, by protective devices (all operators were instructed to wear protective aprons and gloves), and more or less overcome in the other cases by mechanical additions to the table, by means of which the plate and screen could be easily substituted for each other in a holder, the distance of which from the tube was known. Stereoscopic negatives and accurate localizations could easily be obtained. This has proved to be the most practicable method of dealing with the routine of military skiagraphy. A short account of the method adopted in searching for and localizing a "foreign body" may not be out of place.

The patient is carried into the X-ray room on a stretcher, which is placed on the table. The poles and end pieces of the stretcher are then withdrawn, leaving the patient on the canvas of the stretcher. Previous to this the entrance wound has been marked by placing a piece of coiled wire just on top of the dressing, underneath the bandages. The room is then darkened, and the tube moved about until the image of the missile is seen on the screen. The iris diaphragm is then closed, until the image of the "foreign body" is accurately in the centre. The diaphragm is then opened as much as is required, and, as the tube also has previously been centred in the tube box, it is only necessary to read off on the upright pillar the distance of the tube from the screen in order to be able to carry out the combined method of stereoscopic and simple distance reading localization, which is usually adopted. This is done as follows: The tube box is shifted from the centre three centimetres, and a plate taken, then three centimetres from the centre the other way, and a second plate taken. The two plates are subsequently compared and the displacement of the two shadows transferred to a piece of transparent celluloid or paper. The negatives themselves are examined in the new type of portable stereoscope, the advantage of which is that it can easily be carried into the operating room, which in nearly every hospital is now supplied with electric light, and being placed on a small table by the surgeon's side can be referred to when required. The actual distance of the bullet from the surface can be ascertained from the measurements taken, either by means of the Mackenzie Davidson localizer, which gives the position in all three dimensions of space, or by the simpler method of a modification of Hampson's localizer, which hangs on the wall of the X-ray room, and is manipulated by merely adjusting the position of two strings attached to slides, and which gives the position of the "foreign body" in one dimension of space in a few seconds.

There has been a considerable discussion during this War as to the advantages and disadvantages of the various methods of localization as practised by various radiographers, the character of the arguments implying rather that the main object and end of the radiographical examination is the ability to be able to state to the surgeon the exact distance in inches or millimetres of the "foreign body" below any known surface marking. No doubt in some cases, especially in brain surgery, this information is of great value, but there is a tendency for its importance to be exaggerated, especially as nearly every surgeon has his own pet method of localization, which he wishes the radiographer to carry out, and this unfortunate man is supposed to have at his fingers' ends Brown's modification of Smith's method, etc., for the use of the surgeon interested. It was manifestly impossible for the radiographers to be completely *au fait* with all these methods, and so the standard method already described was adopted. The Mackenzie Davidson method, excellent as it is and indispensable in eye cases, etc., was found to take up too much time and to be too delicate for routine work, and so the modification of Hampson's method already described was adopted.

Now as regards some details of the actual arrangements for producing the high potential current necessary for lighting up the tube. The coil in every radiographic outfit is designed to work under four different conditions, i.e., 220 and 100 volts, shunt and accumulators. Now a coil constructed on this compromise principle can never be quite as efficient as one made to work for any one particular voltage, but it was thought advisable to adopt this plan in order to be able to use the main town current. In towns like Boulogne, which have a direct current supply, this arrangement was admirable, but in most other French towns an alternating current was the rule, and consequently an arrangement had to be thought out by means of which the alternating could be turned into direct current. Various schemes were considered, and eventually an alternating current break was adopted in one of the hospitals at Rouen, and has proved such a success that its adoption in all the camp hospitals at Rouen has been recommended. A word of explanation is here necessary.

All the outfits are supplied with accumulators of 36 volts, and a petrol dynamo engine set for charging them. Now, the power given out by the coil under these circumstances, i.e., with the accumulators, was sufficient, with rather long exposures, to radiograph every part of the body, but it rendered the performance of screen examinations very difficult, and so in order to reduce the time of exposure and to render radioscopy easier, the installation of an alternating current break was adapted, this method doubling or trebling the output from the tube at very little extra cost and causing considerable saving of trouble.

The original coils sent out at the beginning of the War had necessarily suffered much rough treatment, especially during the "retreat," and so

it was not surprising to find that some of them had partially or completely broken down, but taking things as a whole the apparatus has withstood the rough knocking about very well, and at the end of May all the apparatus at Rouen, the last base visited, was in good working order.

Just a word about the hospitals near the fighting line. These hospitals evacuate so fast that in most cases X-rays are not needed, and there are military reasons, I believe, why permanent installations are undesirable. But there are undoubtedly occasions when some form of radiography would be of great advantage, for instance, when performing brain operations on a case when the presence of fragments of shell, &c., is suspected, but not known. Consequently, a mobile X-ray unit, a present from the Ladies' School at Cheltenham, in the form of a motor lorry, completely equipped with everything necessary in the radiographical line, has been sent up to the Front in charge of Lieutenant Lang, who is responsible for designing and fitting out this car.

During the last few months the various installations have been erected in rooms adjoining or as near as possible to the operating theatre. In some cases when the hospital has been a hotel or disused house, this has been impossible, and the quarters necessarily in some cases are very cramped. In places where the hospitals are in huts a very fine accommodation for the X-ray plant has been provided next to the operating room. The personnel consists as a rule of a lieutenant in charge, who may or may not have beds to look after as well, and one or two orderlies. The surgeons, as a rule, prefer to examine the plates and make their own diagnoses, and as the diagnosis is as a rule quite straightforward this method answers very well. Occasionally, however, interesting cases outside the military line turn up, but it speaks volumes for the health of the troops to be able to state that pure medical radiography is extremely rare. Apart from diagnosing fractures, pieces of metal and their position, the most interesting work is in connection with wounds of the chest and their sequelæ, and wounds of the head and spine, with their concomitant sensory and motor symptoms. In these cases the co-operation of nerve specialist and radiographer in diagnosing the exact position of the missile is of great assistance to the surgeon, and at the beginning of the War I was lucky enough for a short time to be able to take part in the work performed by Dr. Gordon Holmes and Mr. Sargent at Paris. The diagnosis as to the exact position of the (say) bullet was made independently by the physician and radiographer, and the results were compared before and after operation.

Translation.

NOTES ON ACUTE MENINGITIS AMONG TROOPS IN THE FIELD.[1]

By Drs. SACQUÉPÉE, BURNET, and WEISSENBACH.

Bacteriological Laboratory of the IVth Army.

Our knowledge — clinical and bacteriological — on the subject of purulent meningitis is of comparatively recent date. The disease does not seem to have been investigated in the course of antecedent great wars. Its appearances among the troops of the 4th Army in the course of the present War give occasion for the following observations.

The number of cases that came to light from January to the end of June is equal to a ratio of 30 to 35 per 100,000 of the effective strength, a figure practically identical with that given by military medical statistics for the same period of the year in peace time. The occurrence rate of acute meningitis is thus shown to be the same in war-time as it was prior to the War. Notwithstanding this numerical similarity the cases of purulent meningitis[2] among the troops on service present certain special features.

First, as regards ætiology. The actual producing agents of the cases of meningitis investigated are, in point of fact, very varied. In a total of one hundred and twenty-one cerebrospinal fluids taken from cases of purulent meningitis we found the meningococcus present in sixty-two instances, i.e., approximately fifty per cent. In order to grasp the significance of these figures it must be borne in mind that before the War the meningococcus was quite commonly the *causa causans* in cases of purulent meningitis in military groups; if the proportion of such cases is put at between eighty and ninety per cent. the actual truth cannot be far departed from. Since the War cases of meningitis due to the presence of the meningococcus have shown themselves absolutely and relatively less frequently than before the War began.

Out of the remaining cases of purulent meningitis ten could not be studied in their entirety; while forty were due to the presence of various pathogenic organisms—parameningococcus, *Diplococcus crassus*, *D. flavus*, *Micrococcus catarrhalis* – others showed pseudo-meningococcus, streptococcus, pneumococcus, staphylococcus, tetragenes, enterococcus, pneumobacillus, *Bacillus paratyphosus* A. This list includes really all the pseudo-meningococci and all the pyogenetics.

Finally, six cerebrospinal fluids (a relatively higher proportion)

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[1] Translated from *Bulletin de l'Académie de Médecine*, No. 30, Séance du 27 Juillet, 1915.

[2] "Les méningites purulentes."

showed the features of the puriform aseptic meningitis of Widal, i.e., integrity of polynuclei, trifling increase of albumin; persistence of or increased power of reducing Fehling's solution; absence of organisms discoverable by means of direct examination or by cultivations. Correlatively, the six patients (from whom these cerebrospinal fluids were drawn) recovered with a rapidity which was quite remarkable.

As regards the actual producing agent of meningitis, the principal facts may be summarized as follows:—

For the whole group of cases investigated the number of those due to the presence of the meningococcus was only slightly in majority; cases of meningitis produced by other organisms are relatively numerous; aseptic puriform[1] reactions are by no means exceptional.

Having regard to the actual state of our knowledge of the method of transmission of cerebrospinal meningitis, there was reason to keep a look-out for "carriers" among those in contact with the patients suffering from cerebrospinal meningitis due to the meningococcus.

According to the tabular statement drawn up by one of us, in peace time, the average proportion of "carriers" among the "contacts" of the cases of this illness is from four to five per cent. Bacteriological examination, as far as possible under the same conditions, shows that the average proportion of "carriers" among troops on active service is about 1·33 per cent.

In view of the large number of examinations made by us these figures deserve some degree of consideration. They point to the fact that among the troops on active service the number of "carriers" is only one-third of the total number found among the troops previous to the War. Without labouring the point, it seems natural to establish a close connection between the diminished prevalence of meningococcal meningitis and the relative scarcity of "carriers" among those in contact with the patients. This scarcity of "carriers" is not surprising. The men are seldom so packed together that the word "overcrowding" can be used; the out-door life is a protection.

There has been no "epidemic" properly so called; but two groups of cases conveyed an impression of such prevalence, One of these prevalences necessitated our dealing with five successive attacks in the same regiment, in the space of six weeks; the two first attacks were meningococcal in origin; two others were due to the pneumococcus; the last was due to the streptococcus.

Notwithstanding the number and the close connection of the attacked, there was not, for that reason, any question of an epidemic, properly so called, of cerebrospinal meningitis, but merely of the linking together of several successive attacks of sporadic meningitis due to different species of micro-organisms.

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[1] "Des réactions puriformes aseptiques."

It may be asked why the conditions brought about by the War have given rise to an unwonted number of cases of meningitis of various different types—some due to micro-organisms not usually showing a special affinity for the meninges; others exhibiting aseptic puriform[1] reactions which are probably due to the action of virus, or toxins, especially toxins of microbic origin, on the cerebrospinal membranes.

In our opinion, certain secondary causes must be playing a leading part in this connection, viz., fatigue, want of sleep, and especially the violent disturbance (*ébranlement*) produced in the cerebrospinal substance by the abrupt and sudden change of pressure caused by the bursting of explosives. These enormous changes of pressure may bring about grave symptoms constituting the aggregate of symptoms in caisson disease. Less violent, but constantly repeated, they cause a kind of hammering upon the central nervous tissue; a hammering which, in the end, must have the effect of rendering the nervous tissues specially vulnerable to the attacks of previously existing pathogenic organisms or to the action of the toxins elaborated by them. This explanation seems to us all the more reasonable because, in addition to the purulent lesions which, here, we have especially in view, we have also observed a large number (forty-two) of more elementary reactions characterized by an assemblage of the clinical features of meningitis, with or without meningeal cellular changes. Does not this mildness of symptoms undoubtedly indicate that the lesions are quite trifling, and not specifically infected?

In conclusion, it is impossible not to take into account the condition of "nerve strain," to use a current expression, to which the soldiers in the trenches are exposed during the hours, and, indeed, whole days, of bombardment; a condition so evident that competent observers have characterized it as a really pathological mental state which cannot possibly leave the nervous centres unaffected.

Current Literature.

Cholera.—Professor J. Kaup, of Munich, Consulting Hygienist with an Austrian Headquarters, reports (in No. 11 *Münch. med. Woch.*, p. 378, March 16, 1915) the results of protective cholera inoculations in the Austrian armies. First cases appeared on September 20, 1914, in a regiment belonging to an Eastern Galician army then in retreat. The regiment was promptly vaccinated; the vaccination was completed by the end of September. All other divisions of the same unit were inoculated, and, when completed, the attack-rate fell to one in ten, and then no cases were reported.

The vaccine consisted of an emulsion of vibrio in a 0·5 per cent. carbolic saline, killed at 53° C. First dose 1 c.c.; second dose, after six

[1] "Des réactions puriformes aseptiques."

to eight days, 2 c.c.; (1 c.c. appears to contain two loopfuls of an agar slant twenty-four hours' growth). No reaction followed the inoculations.

One of the above divisions, not vaccinated in time, was moved west to join another army, and as a consequence, cholera cases began to appear. The men were injected during incubation; after the first dose the disease took a very much milder course, and the mortality was much lower.

In another unvaccinated army corps, cholera was immediately stopped after first inoculation.

Still another *vaccinated* corps was operating in an infected area all through November, and a few cases only were notified. The ratio of men who had two doses, one dose and the non-vaccinated ones was 20 : 5 : 2.

The morbidity rate amongst the above groups was 24 : 62 : 80. Generally speaking, there were notified:—

1 to 2 cases per 10,000 twice inoculated.
15 ,, ,, once inoculated.
50 ,, ,, non-vaccinated.

In the 3rd army many cases appeared in middle of October. On account of many difficulties, the vaccination was completed in the beginning of November only, and the disease was stopped. One of the army corps may serve as an illustration: Cases daily reported in October; vaccination completed by November 3. Since November 8 no more cases reported.

Out of 1,861 non-vaccinated, there died ... 545 = 29·3 per cent.
,, 299 twice vaccinated, there died ... 3 = 1 ,,
and 7 deaths amongst the once vaccinated (number not quoted).

As a result of the above successful vaccinations, all the "Ersatz" formations at home were compulsorily vaccinated twice.

4th Army: History as with 3rd army. General result: per 10,000 non-vaccinated—twenty cases; once vaccinated—three cases; fully vaccinated—one case only.

It must be emphasized that the extraordinary reduction of cases was not due to natural causes, viz., approaching winter. In winter one of the non-vaccinated formations was infected by carriers, and the disease began rapidly to spread. First case was notified on December 16. By January 16 the outbreak was arrested. No one on the vaccinated staff of the cholera hospital was taken ill. The mortality data for this outbreak were:—

778 non-vaccinated	...	...	303 = 39 per cent.
151 once vaccinated	...	...	39 = 26 ,,
40 twice vaccinated	...	...	6 = 15 ,,

The writer and the military authorities with him consider the vaccination to be the only possible and reliable protection of the troops on a terrain where big and rapid movements of troops take place constantly, and where it is impossible to ensure reasonable sanitary measures outside the military camps. Over 1,000,000 soldiers in all were vaccinated.

It has been noted, but no figures are given, that the percentage of cholera carriers is greater amongst the vaccinated soldiers.

The question of the duration of the protection is at present attracting a good deal of interest. The Balkan War experience has shown that six months is a minimum period of reliable immunity. Nine months are

tentatively advanced now as a minimum, but a re-vaccination of the troops is considered necessary.

Rosenthal and Werz, Military Hospitals, Nürnberg (*Münch med. Woch.*, p. 382, No. 11, March 16, 1915).—As the whole of the *German* armies were not vaccinated against cholera, isolated cases amongst the wounded brought home from the Polish battlefields were occasionally reported. Also numerous cases amongst the Russian prisoners in various camps. *It is interesting to record that many wounded are cholera carriers without any symptoms.* In December some 686 wounded were brought from Poland directly to the Nürnberg hospitals. One died of atypical cholera diagnosed on *post-mortem* only; thereupon all the rest were examined, and ten carriers were found. The twelfth case was a wounded man, brought in November, who developed an acute intestinal disease in December, and who was ultimately found to be infected with typhoid and cholera simultaneously. Amongst the twelve carriers nine showed no specific agglutination, two moderate agglutination.

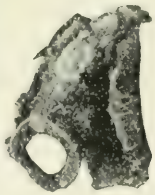
An analysis of some 250 of the above cases shows that the percentage of carriers is about three amongst the non-vaccinated and eight amongst the vaccinated.

It is recommended that finely powdered and officially tested animal charcoal be used for the treatment of cholera and dysentery. The charcoal acts as a powerful absorbing agent, and is said to give very successful results in apparently desperate cases. It must be tested both chemically and biologically, as there is a great variation in the absorbing properties of various samples (Wiechowski and others).

Typhoid. — (1) It is universally reported that blood cultures in *vaccinated* typhoid patients are, as a rule, negative. This is considered a great drawback, particularly as regards differential diagnosis between typhus and typhoid fever. As the agglutination test is also inapplicable in vaccinated patients, it is urged that the search for typhoid bacilli in fæces and urine is alone reliable as a bacteriological diagnosis. Max Neisser (*Munch. med. Woch.*, p. 142, No. 4, 1915) reported to a meeting of military surgeons of the V Army, on December 15, that under the circumstances the diazo test was more reliable than the blood culture (81 per cent. positive results as against 56 per cent. positive blood cultures in 700 typhoid patients examined during six weeks).

(2) Many attempts are being made, both in Austria-Hungary and Germany, to evolve a bacterial treatment of typhoid fever. Intravenous injections of typhoid vaccines, sensitized or not, are generally recommended. The dose is usually 0·5 to 1·2 c.c. of an ordinary vaccine containing 500 bacilli to 1 c.c. The reaction is very severe; critical fall of temperature, often far below the normal, sometimes collapse, &c. In straightforward, and generally in uncomplicated cases the effect of the injection is said to consist in a permanent reduction of the temperature, in an immediate general improvement, and in considerably shortening the course of the disease. In complicated cases, particularly when pneumonia and bronchitis supervene, the vaccine treatment fails, or gives, at the best, a temporary relief only.

R. Paltauf, of the Serum Institute in Vienna, whilst confirming the general belief in the efficacy of the treatment, warns against indiscriminate application, and limits its use to large hospitals only.



To illustrate "A Case of Dumdum Bullet Wound," by Stabsarzt d. L. Dr. F. Sudendorf.

Neo-salvarsan (0·3 c.c., intravenously) is claimed by Professor Jacob to give results similar to those obtained with vaccine treatment.

Lastly, Lüdke recommends intravenous injections of deutero-albumose (1 c.c. of a 2 to 4 per cent. solution), since it is albumen and not specific antigen which, in his opinion, produces beneficial results.

A Case of Dumdum Bullet Wound.—Reported from the Reserve Hospital in Bautzen by Stabsarzt d. L. Dr. F. Sudendorf in the *Münch. med. Woch.*, February 9, 1915, p. 210. Reservist A. K., of the Infantry Regiment 103, Company 12, stated that the bullet wound of his right upper arm was received on September 20, 1914, before Laon, while storming the position of the English. When he was admitted to hospital on September 26 the following condition was found:—

Immediately above the right elbow-joint a wound of entry existed on the flexor aspect of the arm, on both sides of the tendon of the biceps. On the extensor aspect of the arm were two wounds of exit, one below and one above the right elbow-joint. None of the four openings was very large, the largest being those on the flexor and radial aspect. There was considerable discharge from the wounds above the elbow-joint, which, together with the lower third of the upper arm, was much swollen and inflamed, the overlying skin being reddened. The X-rays showed in the neighbourhood of the wound of entry, over the lower third of the upper arm, fragments of lead, scattered in profusion, of the size of small shot (calibre 0) and four or five times larger (buck-shot and larger).

A Dumdum wound of the right upper arm was diagnosed. In the course of treatment incisions were twice necessary. Through one, made on the extensor aspect of the joint, a great number of large and small fragments of lead were removed or came away of themselves. As, however, the joint threatened to become fixed, a general anæsthetic was given on October 26, a deep incision was made over the large wound of entry, and the outer covering (Mantel) of the Dumdum bullet was removed. The photograph shows plainly the opening at the point of the bullet, although it had been completely deformed. During the daily changes of dressing, small and minute fragments of lead were regularly discharged from the cavity of the wound (see illustration).

The Action of the Regular Infantry Bullet and of the Dumdum Bullet on the Human Body (Comments on M. Kirschener's publication by Professor G. Perthes, Generaloberarztes and Consulting Surgeon to the 13th Army Corps (K.W.), from the *Münch. med. Woch.*, February 9, 1915, p. 210).—Kirschener's communication to this journal for December 29, 1914, No. 52, contains conclusions with regard to the action of Dumdum bullets, which should not remain uncontradicted, on account of the interest shown in the demonstrability of Dumdum wounds.

It is difficult to agree with Kirschener when he says that the conclusion cannot safely be drawn from a very large and much torn wound, that a partially covered bullet (Teilmantelgeschoss) has been used, nor can I subscribe to the sentence in which Kirschener says of the action of the Dumdum bullet: "If a Dumdum bullet strikes only soft structures, it acts exactly like a regular infantry projectile. Its specific action comes into play only when it strikes a bone." The reverse of this proposition is the case.

As is well known, the explosive action of the "Teilmantelgeschoss depends on the obstruction opposed to the covering of the bullet when it strikes an object. The lead is carried through the opening in the point of the bullet, the outer covering of which is lacerated and is itself broken up into numerous small fragments, which cause extensive destruction in the surrounding tissues. Now it is of importance that not only bones but also the soft tissues cause sufficient obstruction to delay the passage of the outer casing, as compared with the core, and thus to separate the casing from the core, and to scatter the core broadcast. This fact, which is denied by Kirschener, has been proved to me by a small series of shooting experiments on horses which I made long before Kirschener's communication appeared. Previously I had repeated yearly the shooting experiments with Dumdum bullets by v. Bruns, my predecessor at the hospital in Tubingen, and have collected my own experiences in this question. The results of these shots at the bodies of horses, which had just been killed by a bullet in the head, were immediately investigated by exact anatomical investigations after every shot, and notes were made. Carbines were used, and the German infantry bullet, which was converted into a "Teilmantelgeschoss" by filing off its point. When I dismiss the shots which caused slight lesions of bone, there remain three shots through the upper part of the leg, involving only the soft structures. The distances at which these shots were fired were 20, 100 and 160 metres respectively. In each case there was a wound of entry corresponding to the size of the bullet. Beyond this there was a large lacerated cavity, occupying the whole length of the channel made by the bullet. This cavity could easily hold a fist in the case in which the range was only 20 metres. In the case in which it was 100 metres, the wound cavity was larger than a goose's egg, and in the case in which the range was 160 metres, the channel formed by the bullet easily transmitted two fingers. The wound of exit at the range of 20 metres was 8 by 5 cm. and irregularly torn. The wounds of exit at the ranges of 100 and 160 metres were slit-like and only a little bigger than the wounds of entry. In all three cases the wound cavity contained more or less numerous fragments of lead, varying in size from a pin's head to a lentil. In the wound inflicted at the range of 100 metres were some portions of the outer casing. The outer casing of the bullet fired at the range of 160 metres was found to have passed through the body of the horse, and though much torn, was almost complete and was free of its leaden core. A control shot [evidently with a German infantry bullet, not converted into a Dumdum—Translator] through the soft parts of the upper portion of the leg of a horse at a range of 20 metres showed on dissection a simple seton-like channel.

The experiments show clearly that not only the bones, but also the soft tissues afford sufficient resistance to provoke the explosive action of the "Teilmantelgeschoss," and to scatter the lead core in the smallest fragments. They show further, in complete unison with the results of six carefully examined experimental shots through bones, that the explosive action of the Dumdum bullet rapidly diminishes with the distance, and that at a distance of 160 metres, the irregular wound cavity forms a channel which is still large enough to admit two fingers.

Kirschener refers to his observations made on wild game in India, according to which the wounds of entry and exit were invariably small.

As our experiments on horses show, a small wound of exit in no way proves the absence of an explosive action. Behind the small opening in the skin there may be a large wound cavity. The small wound of exit is made by the passage of the outer casing (see shot at a range of 160 metres) ; the wound cavity made by the breaking up of the core does not often extend to the wound of exit in horses and big game which present large masses of soft tissue. On the other hand, the human tissues through which a bullet passes are so shallow that the large wound cavity extends to, and involves, the wound of exit, which must therefore be much bigger. It is impossible to take into consideration the experiments made on corpses, referred to by Kirschener, for there are no accurate data, notably no record of the range.

If, as Kirschener asserts, the Dumdum action were to occur only on contact with bone, there would hardly be any regular difference between the Dumdum and the usual infantry bullet, for this, too, at normal close range, at any rate on contact with the shaft of the bone, causes large lacerated wound cavities, owing to the bone being splintered. It is all-important that the explosive action of the Dumdum at short range occurs under every condition. At long range Dumdum bullets may cause no explosive effect. At least this is indicated definitely by the rapidity with which its explosive action diminishes as the range is increased.

A great importance to the question of the demonstrability of the Dumdum wound is the knowledge of the Dumdum action. Kirschener says: "The only sure proof that a wound is inflicted by a Dumdum is the discovery of the projectile in so slightly deformed a state that it is still absolutely demonstrable that the front end of the steel casing has been intentionally broken off before the cartridge was fired."

It is impossible for me to agree with this statement. On the contrary, if in a wound one finds a bullet with the shape of an undischarged Dumdum bullet, then it is proven that the bullet found has not had an explosive Dumdum action. Bullets which have had a Dumdum action can never be the subject of investigation as to the form they possessed before they were discharged, for the essential feature of the Dumdum action consists precisely in the mutilation of the casing and the scattering of the lead core into countless minute fragments of lead. Only when a Dumdum bullet inflicts a wound at a great range and does not, therefore, exercise its destructive action, is it conceivable that it may retain its shape. It may, however, be presumed that the men who shoot with Dumdum bullets know that their Dumdum action can be relied on only at close range, and that therefore they probably use Dumdum bullets only for fighting at short range.

The demonstration of a Dumdum wound is not to be made by the shape of an intact bullet found in it. Much rather is it to be demonstrated by Dumdum wounds inflicted at close range, in which numerous scattered fragments of lead are to be found in the tissues either by the Röntgen rays or—and this is less easy—by dissection.

This discovery of numerous small metallic particles in the wound is an absolutely conclusive proof of the use of Dumdums in fighting with the French. When in a bullet wound, which can only have been inflicted by the French infantry, small quantities of metal are detected, and when it is found that these particles consist of lead, then it is clear that the regular French bullet, which consists of copper and never breaks up into

small particles, has not been used. A "Mantelgeschoss" capable of breaking up must have been discharged

But even with regard to those of our enemies, such as the English and the Russians, who use the "Mantelgeschoss," this method of deciding whether a suspicious wound is really due to a Dumdum bullet is not to be undervalued, not only in the case of wounds of the soft parts alone, but also when bones have been hit. Certainly, after ricochetting, an ordinary "Mantelgeschoss," when striking hard bone, occasionally has its casing broken and its core broken up into fragments. Never, however, does a bullet conforming with the conventions break up into so small and so many particles of metal when meeting firm resistance after ricochetting as we see in Röntgen pictures of Dumdum shooting experiments, and as we see after dissection of Dumdum wound cavities experimentally caused. In these experiments the fragments were more numerous and small, according as the range was shortened. Also, when the regular bullet is reversed so that the case-free base is turned foremost, the same conditions do not exist as in the case of the Dumdum bullet. For when one discharges such a regular bullet with its base foremost, a Dumdum-like action may result at close range, but the conditions are not the same, as has been found by two experiments at a range of 20 metres. The regular S-bullet turns round ("ueberschlagt sich") only when its velocity is reduced by the resistance of the air or other substances. Then, however, the force required to break up the lead core into minute particles no longer exists. That the action of such a reversed regular infantry bullet is essentially different from that of a Dumdum bullet is demonstrated by shooting experiments which I (Professor Perthes) have made in Tubingen, and which I undertook in connection with Fessler's well-known investigations. When one places three pinewood boxes, each 50 cm. deep, together, the first filled with sawdust, and fires at a range of 100 metres, it is possible to follow the gradual rotation of the bullet as it advances sideways, and then turns round on its base. In no case was the separation of the casing from the core, and the breaking up into small metal particles, observed as a result of reversing the bullet; whereas, under similar conditions, the Dumdum bullet broke up into minute particles of lead, as was most beautifully demonstrated on the back wall of the first box, the front of this back wall being covered with cardboard.

We must therefore maintain that the discovery in a wound of particles of lead, of the size of a millet seed and smaller, which are found embedded around the wall of a large wound cavity, definitely indicates under all conditions the presence of a Dumdum wound. It is not denied that it is difficult to demonstrate the existence of a Dumdum wound when it has been inflicted at long range, and when the fragments of lead are few and large.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

AUGUST AND SEPTEMBER, 1915.

War Office,
September 15, 1915.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field:—

Captain Hugh Glencairn Monteith, Royal Army Medical Corps (attached 2nd Battalion, The Duke of Cornwall's Light Infantry).

For conspicuous gallantry and devotion to duty in picking up and attending to the wounded under heavy fire in the actions near St. Jean and Wieltje, east of Ypres, between April 23 and 27, 1915, when the casualties in the battalion to which he was attached were very heavy.

Lieutenant William Brooks Keith, M.B., 1st Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry at Hooge, on the night of April 23 and 24, 1915. When a shell killed two stretcher-bearers who were bringing in a wounded officer, he went out to assist, and under heavy fire brought the wounded officer into the dressing station.

He has performed many acts of a like nature, and has consistently shown coolness and resource under fire.

Captain Kingsmill Williams Jones, M.D., Royal Army Medical Corps (Special Reserve), attached 1st Battalion, East Kent Regiment.

For conspicuous gallantry and devotion to duty at Hooge. During the entire night of August 9 and 10, 1915, and the whole of the following day and night he was attending to and evacuating wounded from the front trenches, time after time exposing himself to shell and rifle fire. He was twice slightly wounded, but stuck to his work with unflagging energy. It was entirely owing to Captain Jones that the crater was successfully evacuated of wounded.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officer in recognition of his gallantry and devotion to duty in the Field:—

Temporary Lieutenant Thomas Lewis Ingram, Royal Army Medical Corps, attached 1st Battalion, The King's (Shropshire Light Infantry).

For conspicuous devotion to duty and energy at Hooge. He was evacuating wounded from the front trenches almost without cessation the entire nights of August 9 and 10, 1915, and his indomitable energy and resource were the means of saving the lives of many severely wounded officers and men. He has previously done consistently good work.

ARMY MEDICAL SERVICE.

The undermentioned temporary Colonels to be temporary Surgeon-Generals :—

Dated September 26, 1915.—Sir George H. Makins, K.C.M.G., C.B., F.R.C.S. ; Sir Anthony A. Bowlby, Kt., K.C.M.G., F.R.C.S.

Colonel Robert S. F. Henderson, K.H.P., is seconded for service under the Colonial Office, dated July 24, 1915.

ROYAL ARMY MEDICAL CORPS.

The undermentioned to be temporary Lieutenant-Colonels :—

Dated April 28, 1915.—Herbert George Ashwell whilst employed at the Bagthorpe War Hospital.

Dated August 10, 1915.—Temporary Honorary Lieutenant-Colonel Percy Sargent, M.B., F.R.C.S. ; Temporary and Honorary Major Gordon M. Holmes, M.D.

The undermentioned to be temporary Major : –

Dated August 30, 1915.—Robert Thornton Meadows, M.D., late Surgeon-Major, Army Medical Reserve of Officers.

Lieutenant-Colonel Thomas F. Dewar, M.D., from Sanitary Service to be Deputy Assistant Director of Medical Services, Highland Division, dated April 23, 1915.

Second Lieutenant George Min Adam, M.B., from 5th Battalion (Angus and Dundee) (Territorial), The Black Watch (Royal Highlanders), to be temporary Lieutenant, dated April 7, 1915. (Substituted for the notification which appeared in the *Gazette* of May 3, 1915.)

Major Edward H. Myddelton-Gavey, from the Territorial Force Reserve, to be Deputy Assistant Director of Medical Services, 2nd Army, Central Force, dated June 5, 1915.

Lieutenant-Colonel Sir J. R. A. Clark, Bt., C.B., F.R.C.S.Ed., Unattached List, Territorial Force, to be temporary Lieutenant-Colonel whilst in charge of the St. John Ambulance Brigade Hospital, dated July 14, 1915.

Arthur Godfrey Wilkins, M.B., to be temporary Honorary Captain whilst serving with No. 5 British Red Cross Hospital, dated July 26, 1915.

The appointment to a temporary Lieutenancy of Arthur Geoffrey Owen, M.D., notified in the *Gazette* of July 26, 1915, is cancelled.

Major Charles H. Fagge, M.B., F.R.C.S., 2nd London (City of London) General Hospital, to be temporary Honorary Lieutenant-Colonel, and to remain seconded whilst serving with the Hampstead Military Hospital, dated July 28, 1915.

Sir John Collie, Kt., M.D., to be temporary Honorary Major, dated July 30, 1915.

The notification regarding temporary Honorary Lieutenant William F. Thompson, which appeared in the *Gazette* of August 7, 1915, is cancelled.

William Durward Cruickshank, M.B., to be temporary Honorary Lieutenant, dated August 9, 1915.

Temporary Major C. Gordon Watson, F.R.C.S., to be temporary Honorary Lieutenant-Colonel whilst serving with No. 1 British Red Cross Hospital, dated August 11, 1915.

Alexander Robert Ferguson, M.D., to be temporary Major, dated August 12, 1915.

Major Augustus A. W. Merrick, F.R.C.S., from the 3rd West Lancashire Field Ambulance, to be Deputy Assistant Director of Medical Services, 2nd Mounted (Reserve) Division, dated August 14, 1915.

The name of temporary Lieutenant Livingston Gilbert Gunne, M.D., is as now described, and not as stated in the *Gazette* of August 17, 1915.

Major Frederic W. Lamballe, M.B., from the Half-pay List, to be restored to the establishment, dated August 19, 1915.

The undermentioned temporary Lieutenants to be temporary Captains :—

Dated July 17, 1915.—Patrick Hunter Gillies, M.B., late Captain, 8th (Argyllshire) Battalion (Territorial), Princess Louise's (Argyll and Sutherland Highlanders) ; Captain Norval James Watt, M.B., South African Medical Corps.

Dated August 5, 1915.—Thomas H. Pettit, M.B.

Dated August 6, 1915.—Henry William Marett Tims.

Dated August 7, 1915.—Harold John Huchens, D.S.O., late Second Lieutenant Officers Training Corps, and Captain Australian Army Medical Service.

Dated August 16, 1915.—Lionel C. E. Murphy.

Dated August 17, 1915. – Henry C. E. Quin.

Dated August 23, 1915.—James Fairley, M.D.

Dated August 24, 1915.—Howard H. Hepburn, M.D.; Ambrose L. Lockwood, M.D.; John M. Stenhouse, M.B.; Henry William Drew, F.R.C.S.; William G. Davies.

Dated August 25, 1915.—Francis A. Osborn.

Dated August 26, 1915.—Hedley Boyers, M.B.

Dated August 27, 1915.—James B. Cruickshank, M.B.; William Frier, M.B.

Dated August 28, 1915.—Tom Bragg; Frank A. Hampton, M.B.; John I. Johnson; Arthur V. Poyser, M.B.

Dated August 29, 1915.—John F. Barr, M.D.; Geoffrey M. Cowper; Alexander Lundie, M.B.; Lawrence T. Stewart, M.B.; Matthew White, M.B.; Percy E. Adams, M.D.; William B. G. Angus, M.B.

Dated August 31, 1915.—John M. Johnston, M.B.; Herbert C. Lucey, M.D.; Wallis J. Paramore; Douglas B. Spence; Ralph J. Tait, M.B.; Robert F. Young, M.B.

The appointment to a temporary Lieutenancy of Thomas Ewart Ashley is ante-dated to April 26, 1915.

The undermentioned to be temporary Captains:—

Dated August 23, 1915.—Edward Postle Gwyn Causton, late Staff-Surgeon, Royal Navy.

Dated September 1, 1915.—Alma Percy Ford; Alexander Dingwall-Fordyce, M.D.; Horace Dorset Eccles.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated July 13, 1915.—Philip C. P. Cloake relinquishes his commission on account of ill-health.

Dated August 5, 1915.—George S. Sims, M.D.

Dated August 11, 1915.—Moses J. Rowlands, M.D.

Dated August 15, 1915.—Louis D. Cohen.

Dated September 1, 1915.—Roy R. Kerr, M.B.

The undermentioned temporary Captains relinquish their commissions:—

Dated August 4, 1915.—Robert S. Cocke, F.R.C.S.Edin.

Dated August 8, 1915.—W. W. C. Topley, M.B.

Dated August 22, 1915.—Ewen C. Stabb, F.R.C.S.

The undermentioned to be temporary Lieutenants:—

Dated June 10, 1915.—Charles Richard Wills, M.B.

Dated July 6, 1915.—Leslie Burton Burnett, M.B.

Dated July 13, 1915.—John Gordon Thomson, M.B.; Douglas Rodger, M.B., F.R.C.S.Edin.; William Young, M.D., F.R.C.S.Edin.

Dated July 16, 1915.—Thomas Clark Ritchie, M.D.

Dated July 17, 1915.—John Edmund Power, M.B.; Allan Lindsey Saunders; Andrew Peden, M.B.; Arthur Frederick Flower; Kenneth Bernard Pinson, M.B.; Edmund Duncan Franchell Hayes, M.B.; George Oliver Fairclough Alley, M.B.; Frederick Green, M.D.; Sydney Garrat Vinter; Harry Armstrong; John Cecil Fisher, M.B.; Archibald Douglas Hamilton, M.B.; Frederick George Ralston, M.B.; Donald Renton, M.B.; Louis Stephen Shoosmith; Edward Howard Paddison, M.D.; Robert Dow, M.B.; Alan Gibb Crook, M.B.; Neil MacLeod, M.B.; John Mellon Smeaton; Guido De Piro D'Amico, M.D.; Thomas Somerville Reeves; Montagu Travers Morgan, M.B.; Arthur William Baker, M.B.; Philip Vanner Earley, M.B.

Dated July 19, 1915.—James Roy McVail, M.B.; Henry Potter Hall, M.B.; George Buchanan, M.B.; Augustine Fitzgerald Studdert; Geoffrey Ratcliffe Plaister; Alexander Russell Young; Campbell Lamont Miller, M.B.; Edwin Algernon Lindsey; Abraham Zadok Philips, M.D.; Henry Little Hardy Greer, M.B.; Arthur John Wellington Cunningham, M.D.; Fraser McEwen Sinclair, M.B.; James Cook, M.B.; Adam Patrick, M.D.; Frank Beauchamp Martin, M.B., F.R.C.S.; Robert Neville Geach, F.R.C.S.

Dated July 20, 1915.—Joseph Patrick, M.B.; David Glen, M.B; Alexander Gibson, M.B., F.R.C.S.

Dated July 21, 1915.—Charles Bromley Davies; Warrington Yorke, M.D.; James Charles Spillane, M.B.; William Cranfuird McNaghton Dickey; William Cochran Burns, M.D.; Robert Tait McKenzie, M.D.; Herbert Sydney Smith, M.B.

Dated July 22, 1915.—Edward Fullerton, M.B.; Patrick Arthur Sullivan; Donald Trench Skeen, M.B.; William Phillips Jones; Cedric Russell, M.B.; Ralph Rimmer, M.B.; Arthur Cundell Major; Frederick Cecil Holman Piggott, M.D.

Dated July 23, 1915.—George Maxwell Brown, M.B.; William Balfour Gourlay, M.B.; Samuel Patterson Hodkinson, M.B.; Charles James Young, M.B; David Gould Gardiner, M.B.; Stephen Gerald John Dowling, M.B.; Simon Alexander Kuny, M.B.; Howard Slater, M.D.; Thomas Harold Thomas; John Kilpatrick Stewart, M.B.; John Richmond Bryce, M.D.; Horace Gooch, M.B.

Dated July 24, 1915.—Richard John Attridge, M.D. ; Cecil Francis Brady, M.B. ; John William Riddoch, M.B. ; Arthur Ronald McLachlan, F.R.C.S. ; George Kennedy ; George Adam, M.B.

Dated July 25, 1915.—Duncan Miller, M.B. ; Harry Appleton ; William Keverall McIntyre, M.B.

Dated July 27, 1915.—James Barr ; Robert Lester Donn ; Charles Cyril O'Kell ; Reginald Hugh Simpson, M.B.

Dated August 1, 1915.—Sam Todd.

Dated August 4, 1915.—William Brown Dalgleish.

Dated August 6, 1915.—James Davidson, M.B. ; Stuart Jasper Cowell ; Hugh Llewellyn Glyn Hughes ; John Struan Alexander ; Thomas William Sheldon.

Dated August 7, 1915.—John Crawford Knox, M.B. ; Joseph Alan Longley, M.B., F.R.C.S.Edin. ; Frederick William Hutchinson Hutchinson ; Michael Coghlan, M.B. ; Paul MacDonald Little, M.B. ; George Maudsley Jackson ; Alan Hawkins Morley ; Melville Mortimer Adams, M.B.

Dated August 9, 1915.—Norman Blake Laughton, M.B. ; Thomas Walter Melhuish ; William Durward Cruickshank, M.B.

Dated August 10, 1915.—Brian Whitehead ; Hugh McIntyre ; Arthur Helmuth John Miller.

Dated August 12, 1915.—James Bennett Tombleson, M.B.

Dated August 14, 1915.—Hugh Frederick Sheldon ; Edmund Hughes Flanigan, M.B. ; John Cameron Thomson Teggart, M.B. ; John Franklin Young, M.B. ; William Girdwood, M.B. ; F.R.C.S.Edin. : Arthur Philip Woollright ; Alfred James Ireland, M.B.

Dated August 20, 1915.—Frank John Hathaway, M.D. ; Edward Vincent Williams, M.B. ; John Reginald Arthur Digby Todhunter, M.B. ; John Lindsay, M.D. ; Robert Massie, F.R.C.S.Edin. ; James Reid, M.B. ; William Vincent Johnstone ; Thomas Ayscough Hawkesworth, M.B. ; John Caldwell Ferguson ; John Wishart Welsh Hewitt, M.B. ; William Mason ; Donald Cameron MacLachlan, M.B. ; William Ramsay Nasmyth, M.D., F.R.C.S.Edin. ; William James Dunlop Robertson, M.B. ; George Wright, M.B. ; John Young, M.B. ; John Bain, M.B. ; Robert Whitson Telford, M.D. ; Maurice Gilbert Hannay ; Frank Roland Wallis.

Dated August 21, 1915.—George Walker, M.D. ; Alfred Charles Sandston, M.D. ; Lawrence Sebastian Morgan, M.B.

Dated August 23, 1915.—Frank Stanley Noble, M.D. ; Ralph Davies Smedley, M.D. ; John Arthur Gwynn Sparrow, M.B. ; John Christopher Davies, M.B. ; Duncan Malloch, M.B. ; George Douglas MacKintosh ; Harry Rathbone Griffith, M.B. ; Archibald Todrick, M.B. ; James Williamson Martin, M.D. : Arthur Cecil Laing, M.B. ; Henry Pierce Cuthbert ; Oswald Erasmus Ward ; David Harris Jones, M.B. ; William Frederick Shanks, M.B. ; Arthur Ashmore ; Robert Philip Graham ; John Ferguson Carruthers, M.D. ; William David Bathgate ; Henry John Sullings Kimbell ; Henry George Jamieson, M.D. ; George Agincourt Hodges ; James Taylor Kyle, M.B. ; Edward Wick MacWilliam, M.B. : Thomas Francis Weakliam, M.B. : Rodolphus Whittaker Harper, M.B. ; Edgar Huntley, M.B. ; Joseph Stanislaus Doyle, M.B. ; George Johnston ; David Jackson McAdam, M.B.

Dated August 24, 1915.—Joseph Porter, M.B. ; David Marmaduke Gill, M.B. ; John Dickie, M.B. ; Edward Ratcliffe Holborow, M.B. ; Henry Valentine Fitzgerald ; Walter Gilmour, M.D. ; Emile Horace George Duncan ; David McKail, M.D. ; Richard Alfred Parsons.

Dated August 25, 1915.—Eugene John McSwiney, M.B. ; Andrew William Palethorpe Todd, M.B. : Sidney John Liddon Lindeman ; George Munro, M.B. ; Alexander Rennie, M.B. ; Randal McCarthy.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants :—

Dated August 12, 1915.—Albee Amos Skeels, M.D.

Dated August 20, 1915.—Andrew McConnel Davidson, M.D. ; William James Chapman, M.B. ; Alexander Ross, M.D. ; Dimock Stanley Cassidy, M.D. ; David Alexander Volume, M.D. ; Bernard Francis, M.D. ; Howard Harvey, M.D. ; George Perry Armstrong, M.D. : James Thornley Bowman, M.D. ; Charles Alexander Fox Gaviller, M.D. ; James Frederick Adamson, M.D. : Floyd Cecil Stewart, M.D. ; John Ferrell Wood, M.D. ; William Edward Ainley, M.D. ; George Boyd McTavish, M.D. ; John Robert Irwin, M.B. ; James Blain Haverson, M.D. : Douglas St. Clair Creighton, M.D. ; George Herbert Laurence Armstrong, M.D. ; John Alexander Wellwood, M.D. ; John Frederick Sadleir ; Alexander Russell Munroe, M.D. ; Francis Lorne McKinnon, M.D. ; David Levern Dick, M.B.

Dated August 26, 1915.—Roderick Maclean ; Howell Woodwell Gabe, F.R.C.S.Edin.; Joseph Patrick Dee, M.D. ; James Lyone, M.B. ; George Rae Spence, M.B. ; Dugald Ferguson, M.B.

Dated August 27, 1915.—Thomas Pretsell, M.B. ; Wilfred Barkes, M.D. ; Alexander Whyte Cassie, M.B. ; James Beatty, M.D. ; Robert Percy Weldon ; Reginald Puttock, M.B.

Dated August 28, 1915.—William Thomas Wearing, M.B. ; James Macarthur, M.B. ; Henry St. John Randell, M.B ; Andrew Wight, M.B.

Dated August 30, 1915.—Thomas Milling, M.B. ; Herbert Gibbons Ward, M.D. ; Edward Segnier Sowerby, M.B. ; Herbert Alfred Bodkin.

Dated August 31, 1915.—George Frederick Gill ; George Taylor Gifford, M.D. ; Maurice Frederick Bliss ; Thomas Hitchings James ; Augustus Henry Aldridge ; James Crowley.

Francis Percy Young, M.D., to be temporary honorary Lieutenant whilst serving with No. 1 British Red Cross (the Duchess of Westminster's) Hospital, dated July 1, 1915.

Eric Arnold Scott to be temporary honorary Lieutenant, dated July 24, 1915.

The undermentioned temporary Lieutenants relinquish their commissions :—

Dated August 1, 1915.—John J. L. Ferris, M.B.

Dated August 4, 1915.—James B. Anderson, M.B. ; Thomas E. A. Carr, M.B. ; James G. B. Coleman, M.D. ; Edgar Ashby ; John F. Gill, M.B.

Dated August 8, 1915.—Thomas F. Wyse.

Dated August 10, 1915.—Charles S Atkin ; Cecil K. Attlee ; Edward N. Graham, F.R.C.S. ; Neville C. Wallis ; John Arthur West.

Dated August 11, 1915.—Thomas A. Jones, M.D. ; Andrew B. Lindsay, M.B. ; Charles W. Forsyth, M.B. ; William A. Wilson-Smith, M.D. ; Henry G. Greaves, M.B.

Dated August 14, 1915.—George H. Rodolph.

Dated August 15, 1915.—Stewart R. Douglas.

Dated August 20, 1915.—James Hamilton Fleming relinquishes his commission on account of ill-health.

Dated August 28, 1915.—Edward V. R. Fooks.

Dated August 29, 1915.—John P. Egan.

Dated September 13, 1915.—Arthur W. Hare, M.B., relinquishes his commission on account of ill-health.

Dated August 31, 1915.—Lieutenant J. M. W. Morison relinquishes his temporary honorary commission on ceasing to be employed with No. 6 British Red Cross (Liverpool Merchants' Mobile) Hospital.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant :—

Dated July 24, 1915.—Henry Howell.

Dated July 26, 1915.—Herbert John Willis.

Dated August 26, 1915.—Frederick William O'Connor.

Dated September 6, 1915.—Arthur Bayford Heron ; Oswald Davenport Price.

Quartermaster and Honorary Captain Charles Bere, retired pay, late Royal Army Medical Corps, to be granted the honorary rank of Major ; dated July 15, 1915.

Quartermaster and Honorary Major Thomas Exton, Royal Army Medical Corps, is retained on the Active List under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be Supernumerary ; dated August 11, 1915.

Quartermaster and Honorary Major Harry Godley Hasell, Royal Army Medical Corps, is retained on the Active List under Article 120, Royal Warrant for Pay and Promotion, and to be Supernumerary ; dated August 23, 1915.

Norman Burton to be temporary Quartermaster, Home Hospitals Reserve, with the honorary rank of Lieutenant, dated September 4, 1915.

SPECIAL RESERVE.

Royal Army Medical Corps.

The undermentioned Lieutenants (on probation) are confirmed in their rank : John A. Binning, John E. Rusby.

War Office,
September 10, 1915.

The King has been graciously pleased to confer the Territorial Decoration upon the undermentioned Officers of the Territorial Force, who have been duly recommended for the same under the terms of the Royal Warrant dated August 17, 1908 :—

YEOMANRY.

Norfolk (The King's Own Royal Regiment).—Surgeon-Major John F. Gordon-Dill, M.D.

ROYAL HORSE ARTILLERY.

Shropshire.—Surgeon-Major George Mackie, M.B.

ROYAL ARMY MEDICAL CORPS.

2nd South-Western Mounted Brigade Field Ambulance.—Lieutenant-Colonel Arthur Cary.

TERRITORIAL FORCE.

ROYAL ARMY MEDICAL CORPS.

London Mounted Brigade Field Ambulance.—Lieutenant Harold E. Gibson, M.B., to be Captain, dated April 1, 1915.

1st London (City of London) Field Ambulance.—Lieutenant Martin B. H. Stratford, F.R.C.S.Edin., to be Captain, dated April 1, 1915; Eric G. Gauntlett, M.B., F.R.C.S., dated April 1, 1915; Eric Donaldson, dated April 1, 1915; Lieutenant Roger P. Stewart, M.B., to be Captain, dated August 22, 1915.

1st London (City of London) General Hospital.—Lieutenant William F. Thompson resigns his commission on account of ill-health, dated September 26, 1915.

1st London (City of London) Sanitary Company.—The undermentioned Lieutenants to be Captains: Martin Priest, dated April 1, 1915; Evelyn A. Cooper, dated April 1, 1915; George White, dated June 15, 1915; Robert Jacobs, dated June 15, 1915; Robert Robison, dated July 4, 1915; Andrew A. McWhan, M.B., dated July 11, 1915; Charles N. Draycott, dated July 17, 1915; Constant W. Ponder, dated August 1, 1915; William N. W. Kennedy, M.B., dated August 8, 1915.

1st London Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Hubert J. B. Fry, dated April 1, 1915; Arthur H. Pemberton, dated May 10, 1915.

2nd London (City of London) General Hospital.—Captain Louis A. Dunn, M.B., F.R.C.S., resigns his commission on account of ill-health, dated September 25, 1915.

2nd London (City of London) Field Ambulance.—Lieutenant Leonard A. Harwood to be Captain, dated April 1, 1915; Lieutenant Louis Courtauld, M.B., to be Captain, dated April 1, 1915.

2nd London Sanitary Company.—The undermentioned Lieutenants to be Captains: Arthur H. Savage, M.D., dated April 1, 1915; Arthur G. Atkinson, M.B., dated April 2, 1915; James Clayton, dated April 3, 1915; Lieutenant Ashley G. G. Thompson, M.B., to be Captain, dated April 23, 1915; Chartres A. Molony, dated May 28, 1915; Francis S. Carson, M.B., dated May 31, 1915; John Crawford, M.B., dated June 4, 1915; Kenneth MacLennan, dated June 11, 1915; John H. N. Price, dated June 11, 1915; Patrick A. Galpin, M.D., dated June 17, 1915; George G. Johnstone, M.B., dated June 29, 1915; Walter K. Parbury, dated July 1, 1915; John H. Wood, M.B., dated July 1, 1915; George L. Eastes, dated July 8, 1915; George W. Ellis, dated July 12, 1915; Ernest B. Pike, dated July 15, 1915; Gerald Q. Lennane, F.R.C.S., dated July 20, 1915; Osmond Cattlin to be Lieutenant, dated August 20, 1915.

3rd London (City of London) Field Ambulance.—The undermentioned Lieutenants to be Captains: Frank H. Robbins, dated April 1, 1915; Robert E. Barnsley, dated April 1, 1915; Julian Taylor, F.R.C.S., dated April 1, 1915; Kenneth V. Smith, dated April 19, 1915; Lieutenant Robert W. A. Salmond, M.D., to be Captain, dated May 1, 1915; Leonard H. Wootton, M.B., dated June 10, 1915; Serjeant Cyril Norton, from the Suffolk Yeomanry, to be Transport Officer with the honorary rank of Lieutenant, dated September 29, 1915.

3rd London General Hospital.—The undermentioned Lieutenants to be Captains, and to remain seconded: John St. A. Titmas, dated April 1, 1915; Harry A. Lucas, dated April 1, 1915; John B. Rawlins, dated May 30, 1915; Philip W. Green, dated August 5, 1915; Lieutenant Cecil R. Harrison, M.B., to be Captain, dated June 1, 1915.

4th London Field Ambulance.—The undermentioned Lieutenants to be Captains: Alfred M. Hughes, dated April 1, 1915; John M. Plews, dated April 1, 1915; Arthur E. Ironside, dated April 1, 1915; John A. Watt, M.B., dated April 10, 1915; Leslie P. Harris, dated July 14, 1915; George B. Pritchard, dated August 4, 1915; the date of appointment of Lieutenant William Morgan Langdon is August 2, 1915, and not as stated in the *London Gazette* of August 27, 1915.

4th London General Hospital.—The undermentioned Lieutenants to be Captains: John Everidge, F.R.C.S., dated April 1, 1915; Henry P. Ashe, dated April 1, 1915: George W. Shore, dated April 1, 1915; Charles E. H. Milner, dated April 22, 1915; David E. S. Davies, dated May 18, 1915: Arthur F. Comyn, M.B., dated May 26, 1915: Charles E. W. McDonald, dated June 12, 1915; William King Churchouse to be Lieutenant, dated September 28, 1915.

5th London Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Ernest G. Annis; William B. Hill, M.D.; Hector M. Calder, M.B.; John McMillan, M.B.

6th London Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: William Scarisbrick, M.B.; Thomas Murray; John F. W. Wyer; Frank Coleman; Henry B. F. Dixon, M.B.; Charles R. Woodruff; Wilfred R. Sadler.

The following announcement is substituted for that which appeared in the *London Gazette* of July 10, 1915: Lieutenant Philip S. Price to be Captain, dated April 1, 1915.

William H. Dickinson, dated July 26, 1915.

Captain Edward P. Minett, from the Territorial Reserve, to be Captain, dated August 16, 1915.

1st Highland Field Ambulance.—The undermentioned Captains to be temporary Majors, dated January 14, 1915: John D. Fiddes, M.B., F.R.C.S.Edin.; John H. Stephens, M.B.

3rd Highland Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of August 4, 1915: Lieutenant Frederick C. Chandler, M.B., to be Captain, dated April 19, 1915.

4th Scottish General Hospital.—Captain Hugh Walker, M.B., from list of officers available on mobilization, to be Major on the permanent personnel, dated June 30, 1915.

Lowland Divisional Sanitary Section.—Lieutenant Thomas J. Mackie, M.B., to be Captain, dated April 1, 1915.

1st Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains: Ronald G. Badenoch, M.B., dated April 1, 1915; Francis Metcalfe, M.B., dated April 1, 1915; Roger Errington, M.B., dated April 15, 1915; Hubert Shield, M.B., dated May 1, 1915; John H. Barclay, M.B., dated May 18, 1915; Home A. P. Robertson, M.B., dated July 1, 1915; Kirton I. S. Smith, M.B., dated August 5, 1915.

2nd Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains: Alexander C. C. Lawrence, dated April 1, 1915; William M. Wilson, M.B., dated April 1, 1915; Valentine H. Wardle, dated April 15, 1915; William Smith, M.B., dated June 7, 1915; Thomas W. Crowley, M.D., dated June 15, 1915; William C. Stewart, M.B., F.R.C.S., dated June 22, 1915.

3rd Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: George H. Watson; Arthur C. M. Savege, M.B.

Northumbrian Divisional Sanitary Section.—Lieutenant Sydney J. Clegg, M.D., to be Captain, dated April 1, 1915.

Northumbrian Casualty Clearing Station.—Lieutenant Colin Mearns, M.B., to be Captain, dated April 1, 1915; Arthur Sutcliffe, M.B., dated May 11, 1915; Robert R. Lishman, M.B., dated May 14, 1915; Charles F. M. Saint, M.D., F.R.C.S., dated May 14, 1915; Richard W. Swayne, M.B., dated May 18, 1915.

1st Northern General Hospital.—Herbert Grantham Dodd, M.B., to be Lieutenant, dated August 16, 1915.

1st Southern General Hospital.—Harold Beckwith Whitehouse (late temporary Lieutenant, Royal Army Medical Corps), to be Captain, whose services will be available on mobilization, dated September 24, 1915.

Eastern Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Harold M. McC. Coombs, M.B., dated April 1, 1915; James MacB. Taylor, M.B., dated April 12, 1915; Basil Fawssett, dated May 11, 1915.

2*nd Eastern General Hospital.*—The following announcement is substituted for that which appeared in the *London Gazette* of September 30, 1914: Lieutenant Herbert John Walker, F.R.C.S.Edin., to be Captain on the permanent personnel, dated October 1, 1914.

South-Eastern Mounted Brigade Field Ambulance.—Lieutenant Edgar M. Jenkins, M.B., to be Captain, dated July 1, 1915.

1*st Western General Hospital.*—Captain Robert A. Bickersteth, M.B., F.R.C.S., to be Major, dated July 21, 1915.

2*nd Western General Hospital.*—The undermentioned Lieutenants to be Captains: Charles H. Crawshaw, M.B., dated May 9, 1915; Edward S. Brentnall, M.B., dated May 9, 1915; Thomas P. Kilner, M.B., dated August 24, 1915; Private Stanley Henry Heighway to be Quartermaster, with the honorary rank of Lieutenant.

3*rd Western General Hospital.*—Lieutenant Ivor J. Davies, M.D., to be Captain, dated April 1, 1915.

1*st South-Western Mounted Brigade Field Ambulance.*—Lieutenant William C. Hodges to be Captain, dated April 1, 1915; Lieutenant Leighton H. Hay, M.B., to be Captain, dated April 3, 1915; Captain Charles W. Edwards, F.R.C.S., to be temporary Major, dated July 5, 1915.

2*nd South-Western Mounted Brigade Field Ambulance.*—The undermentioned Lieutenants to be Captains: Philip S. Martin, dated April 1, 1915; Joseph Grant-Johnston, dated June 24, 1915.

1*st East Anglian Field Ambulance.*—Lieutenant Robert Ellis, M.B., to be Captain, dated April 1, 1915.

2*nd East Anglian Field Ambulance.*—The following announcement is substituted for that which appeared in the *London Gazette* of July 1, 1915: Lieutenant James Arthur, M.D., to be Captain, dated April 1, 1915; Lieutenant Archibald B. Pettigrew to be Captain, dated June 14, 1915; Lieutenant Arthur W. Hayward to be Captain, dated July 1, 1915.

3*rd East Anglian Field Ambulance.*—Lieutenant Alexander Cuffe, M.D., F.R.C.S., to be Captain, dated August 19, 1915; Lieutenant Edward K. Goodwin to be Captain, dated August 27, 1915.

1*st South Midland Mounted Brigade Field Ambulance.*—Lieutenant Alexander Leggat, M.B., to be Captain, dated April 1, 1915; Lieutenant Donald Buchanan to be Captain, dated September 25, 1915.

2*nd South Midland Mounted Brigade Field Ambulance.*—Lieutenant-Colonel Arthur Gervase Hendley, retired list, Indian Medical Service, to be Captain (temporary), dated August 11, 1915.

2*nd South Midland Field Ambulance.*—William James Forsyth Craig to be Lieutenant, dated August 27, 1915; Major Francis J. Warwick, M.B., from East Anglian Casualty Clearing Station, to be Major, dated September 25, 1915; Captain Donald Buchanan, from 1st South Midland Mounted Brigade Field Ambulance, to be Captain, dated September 25, 1915.

North Midland Mounted Brigade Field Ambulance.—James Mitchell, M.B., to be Lieutenant, dated September 14, 1915; Major Arthur G. Goodwin, M.B., F.R.C.S., to be temporary Lieutenant-Colonel, dated September 24, 1915; Captain Thomas George Buchanan, M.B., to be temporary Major, dated September 24, 1915.

North Midland Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Montague Dixon, M.D., dated April 16, 1915; Lieutenant William T. Wood to be Captain, dated April 19, 1915; David D. McNeill, dated April 21, 1915; Vincent A. P. Costobadie, F.R.C.S.Edin., dated April 22, 1915; George W. M. Andrew, dated April 22, 1915; James H. Thomas, M.B., dated April 24, 1915.

1*st North Midland Field Ambulance.*—The undermentioned Lieutenants to be Captains: John C. Grieve, M.B., dated April 1, 1915; Ronald B. Berry, M.B., dated April 19, 1915; Francis G. Bennett, dated April 20, 1915; Charles B. Johnstone, M.B., dated May 18, 1915.

2*nd North Midland Field Ambulance.*—The undermentioned Lieutenants to be Captains: Lionel T. Challenor, dated April 1, 1915; Robert B. M. Yates, M.B., dated April 1, 1915; Bertram S. Wills, F.R.C.S., dated April 24, 1915; Thomas Graham, M.B., dated April 26, 1915; Samuel R. Foster, M.B., dated May 27, 1915; Major John E. O'Connor, M.B., from the Sanitary Service, to be Major, dated September 17, 1915.

3*rd North Midland Field Ambulance.*—The undermentioned Lieutenants to be Captains: William Boyd, M.D., F.R.C.S.Edin., dated April 1, 1915; Joseph C. Harris, dated April 1, 1915; Guy F. Haycraft, dated April 1, 1915; Stanley S. B. Harrison, dated April 17, 1915; William B. Williams, M.B., dated July 23, 1915.

Notts and Derby Mounted Brigade, Field Ambulance.—The date of appointment as Lieutenant of David William Griffiths is July 22, 1915, and not as stated in the *London Gazette* of August 23, 1915.

1*st East Lancashire Field Ambulance.*—Captain John Bruce, M.B., to be temporary Major, dated February 15, 1915; Lieutenant Stanley Hodgson, M.D., to be Captain, dated April 10, 1915; Lieutenant Henry E. Fox, M.B., to be Captain, dated April 30, 1915.

2*nd East Lancashire Field Ambulance.*—Lieutenant George R. Hitchin, M.B., to be Captain, dated May 22, 1915.

3*rd East Lancashire Field Ambulance.*—Lieutenant Wilfred E. Rothwell, M.B., to be Captain, dated May 18, 1915; Lieutenant Gerald G. Wray, M.B., to be Captain, dated May 9, 1915.

West Lancashire Casualty Clearing Station.—The following announcement to be substituted for that which appeared in the *London Gazette* of July 10, 1915, Lieutenant William N. W. West-Watson, M.D., to be Captain, dated April 1, 1915.

1*st West Lancashire Field Ambulance.*—John St. George Wilson to be Lieutenant, dated July 24, 1915.

2*nd West Lancashire Field Ambulance.*—The undermentioned Lieutenants to be Captains: William R. Pierce, M.D., dated April 1, 1915; John F. Roberts, M.B., dated April 1, 1915; James H. Rawlinson, M.B., dated April 1, 1915; George C. King, dated May 30, 1915; Herbert E. Marsden, M.B., dated July 1, 1915.

3*rd West Lancashire Field Ambulance.*—Captain Ernest Knight, M.B., to be temporary Major, dated August 14, 1915. The undermentioned Lieutenants to be Captains: Frank Hauxwell, M.B., dated April 1, 1915; Robert D. B. Frew, M.D., dated April 1, 1915; Harry Middleton, M.B., dated April 1, 1915; Adam A. Turner, M.B., dated April 1, 1915; Gilbert W. Rogers, dated June 15, 1915; Walter R. Stephen, M.B., dated August 1, 1915.

South Wales Mounted Brigade Field Ambulance.—Norman Theodore Kingsley Jordan, M.B., to be Lieutenant, dated August 6, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Gerald Douglas Newton to be Lieutenant, dated August 15, 1915.

Welsh Casualty Clearing Station.—Captain Evan J. T. Cory, M.D., from Attached to Units other than Medical Units, to be Captain, dated July 11, 1915; Captain Evan J. T. Cory, M.D., to be temporary Major, dated July 11, 1915.

1*st Welsh Field Ambulance.*—The undermentioned Lieutenants to be Captains: Donald Macaulay, M.B., dated April 1, 1915; Edward B. H. Hughes, dated June 16, 1915; Henry Mills, dated July 26, 1915; Alexander E. Mackenzie, dated July 27, 1915; John S. Tomb, M.B., dated August 1, 1915; O'Connell Sullivan, M.B., to be Lieutenant, dated August 30, 1915.

2*nd Welsh Field Ambulance.*—Lieutenant John P. H. Davies to be Captain, dated June 18, 1915.

3*rd Welsh Field Ambulance.*—Lieutenant Richard J. Isaac to be Captain, dated May 4, 1915; Lieutenant Joseph Carroll, M.B., to be Captain, dated May 13, 1915.

Yorkshire Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: John Downie, M.B.; Edward D. Ellis.

1*st West Riding Field Ambulance.*—The undermentioned Lieutenants to be Captains: Basil Hughes, M.B., F.R.C.S., dated April 1, 1915; Harry Lee, dated April 1, 1915; John C. Metcalfe, M.B., dated April 13, 1915; Frank Wigglesworth, M.B., dated April 30, 1915; John H. Blackburn, M.B., dated May 12, 1915; Lawrence A. Mackenzie, M.B., dated May 17, 1915; John Pinder, dated May 14, 1915; Hugh R. Partridge, dated May 23, 1915; Henry W. Robinson, M.B., dated June 22, 1915.

The following announcement is substituted for that which appeared in the *London Gazette* of August 6, 1915:

Captain Harry W. Shadwell, from Attached to Units other than Medical Units, to be Captain, dated August 7, 1915.

2*nd West Riding Field Ambulance.*—The undermentioned Lieutenants to be Captains: Samuel S. Greaves, dated April 1, 1915; Francis W. Begg, M.B., dated April 5, 1915; Charles N. Smith, M.B., dated April 7, 1915; Hartas Foxton, M.B., dated July 1, 1915; William H. Smailes, M.D., dated June 28, 1915; Benjamin Holroyd, dated July 19, 1915.

3*rd West Riding Field Ambulance.*—The undermentioned Lieutenants to be Captains, dated April 1, 1915: William B. Allen, M.B.; Robert A. Stark, M.B.; John P. Mathews, M.B.; Donald S. Twigg; William W. J. Lawson, M.B., dated April 30, 1915; William T. D. Mart, dated June 11, 1915; Ernest White, dated July 28, 1915.

1*st Wessex Field Ambulance.*—The undermentioned Lieutenants to be Captains: Charles H. Maskew, M.B., dated April 1, 1915; Robert Burgess, dated April 1, 1915; Edmond L. Meynell, M.B., dated April 16, 1915; Fred Ellis, dated April 24, 1915; Claude J. E. Bennett, dated April 26, 1915; John A. Bell, M.B., dated April 26, 1915.

2*nd Wessex Field Ambulance.*—Lieutenant Henry W. Spaight to be Captain, dated April 1, 1915; Arthur C. Hincks, M.B., dated April 1, 1915; Thomas D. Bell, dated April 6, 1915; Angus Cameron, M.B., dated April 12, 1915; William T. P. Meade-King, dated April 13, 1915; George L. K. Pringle, M.D., dated April 19, 1915; Tom R. Kenworthy, dated April 25, 1915; John P. Milton, dated April 26, 1915; William H. H. Bennett, M.B., dated April 30, 1915; William Robertson, M.B., dated May 2, 1915; Henry N. Collier, dated May 20, 1915; Charles F. Backhouse, dated May 22, 1915; Quartermaster-Serjeant William Pickard to be Transport Officer, with the honorary rank of Lieutenant.

3*rd Wessex Field Ambulance.*—The undermentioned Lieutenants to be Captains: Arthur H. Davis, M.B., dated April 26, 1915; Frederick Tooth, dated April 26, 1915; Frederick W. Brunker, dated April 28, 1915; Philip McRitchie, dated April 28, 1915; Frank L. Dickson, M.B., dated April 28, 1915; Frederick B. Stewart, M.B., dated April 29, 1915.

1*st Home Counties Field Ambulance.*—The undermentioned Lieutenants to be Captains: Robert R. J. Holmes, dated April 1, 1915; William B. Keith, M.D., dated April 1, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of July 15, 1915: The undermentioned Lieutenants to be Captains: Duncan M. Johnston, M.B.; Charles W. Greene, M.B., F.R.C.S., dated April 1, 1915; Arthur Maude, dated May 7, 1915; Hugh S. Palmer, M.B., dated May 10, 1915; James E. Turle to be Captain, dated May 14, 1915; Charles H. Gregory, M.D., dated May 14, 1915; Major Joseph Ward to be temporary Lieutenant-Colonel, dated June 5, 1915; John S. Ward, dated June 12, 1915; Lieutenant Richard A. Freeman to be Captain, dated August 10, 1915.

2*nd Home Counties Field Ambulance.*—The undermentioned Lieutenants to be Captains: Arthur C. Watkin, dated April 29, 1915; James W. Cairns, M.D., dated May 4, 1915; Frank Scroggie, M.B., dated May 15, 1915; George M. McGillivray, dated May 30, 1915.

3*rd Home Counties Field Ambulance.*—The undermentioned Lieutenants to be Captains; Alexander H. Brewer, dated April 1, 1915; Frederic E. H. Keogh, dated April 1, 1915. The following announcement is substituted for that which appeared in

the *London Gazette* of July 23, 1915: Lieutenant Alfred E. L. Devonald to be Captain, dated April 1, 1915; Charles E. M. Hey, dated June 8, 1915; Henry W. Wier, dated June 10, 1915; Edgar W. Matthews, M.B., dated June 12, 1915; Henry J. Brownrigg, M.D., dated June 21, 1915; Philip T. Jones, dated June 29, 1915.

TERRITORIAL FORCE RESERVE.

Royal Army Medical Corps.

Colonel Stanley S. Hoyland, M.D., from Assistant Director of Medical Services, East Anglian Division, to be Colonel.

The following announcement is substituted for that which appeared in the *London Gazette* of September 18, 1915:—

Captain William Boyd, M.D., F.R.C.S.Edin., from the 3rd North Midland Field Ambulance, to be Captain, dated September 19, 1915.

Lieutenant William Boyd, M.D., F.R.C.S., from 3rd North Midland Field Ambulance, to be Lieutenant.

Lieutenant Arthur L. Bastable, M.B., from 2nd Northumbrian Field Ambulance, to be Lieutenant, dated August 24, 1915.

Territorial Force Nursing Service.

Miss Florence Tomlin to be Matron, 2nd Northern General Hospital, dated April 21, 1915.

Miss Eliza M. Vezey, to be Matron, 5th London General Hospital, dated August 16, 1915.

Attached to Units other than Medical Units.

The undermentioned Lieutenants to be Captains:—
George H. H. Manfield, dated April 1, 1915.
Sidney Scott, M.B., dated April 1, 1915.
James A. Stenhouse, M.B., dated April 1, 1915.
James A. C. Scott, M.B., dated April 1, 1915.
James Anderson, M.B., dated April 1, 1915.
John E. Brydon, M.B., dated April 1, 1915.
John L. Green, dated April 1, 1915.
Maurice H. Barton, dated April 1, 1915.
George A. Brogden, M.D., dated April 1, 1915.
William Dale, dated April 1, 1915.
Joseph W. Scott, dated April 1, 1915.
Frank R. Armitage, M.B., dated April 1, 1915.
Stanley Southam, dated April 1, 1915.
James H. Crane, M.D., dated April 1, 1915.
Archibald C. Haddow, M.B., dated April 1, 1915.
John G. Cooke, M.B., dated April 1, 1915.
William E. Falconar, M.B., dated April 1, 1915.
Edward J. Blair, M.B., dated April 1, 1915.
Harry W. Shadwell, dated April 1, 1915.
Josiah Walker, M.B., dated April 1, 1915.
Archibald Hamilton, M.B., dated April 2, 1915.
James P. N. Casey, dated April 9, 1915.
Robert E. T. Tatlow, M.D., dated April 10, 1915.
Alfred E. Delgado, M.B., dated April 16, 1915.
Harold D. Lane, dated April 19, 1915.
Frank H. C. Watson, M.B., dated April 24, 1915.
Harry M. Soden, dated May 5, 1915.
John S. Clarke, M.B., dated May 9, 1915.
John J. Porter, dated May 16, 1915.
John C. Marklove, dated May 20, 1915.
Eliezer Coplans, dated May 21, 1915.
William L. R. Wood, dated May 27, 1915.
David A. R. Haddon, M.B., dated May 29, 1915.
Gerald F. Carr, dated June 11, 1915.
Henry C. C. Hackney, dated June 17, 1915.

Thomas R. W. Atkins, dated June 26, 1915.
John S. Hall, M.B., dated August 1, 1915.
Hugh B. Cunningham, M.B., dated August 12, 1915.
Temporary Major Antony A. Martin, M.D., from 2nd Home Counties Field Ambulance, to be Major (temporary), dated September 12, 1915.
Lieutenant William M. Cox, from South Midland Casualty Clearing Station, to be Lieutenant, dated September 28, 1915.
The undermentioned Lieutenants to be Captains:—
Edward Bromet, dated April 1, 1915.
William Rogers, M.D., dated April 1, 1915.
Godfrey K. Maurice, dated April 1, 1915.
William T. Briscoe, dated April 1, 1915.
Andrew Baxter, M.D., dated April 1, 1915.
Morrice Greer, dated April 1, 1915.
William Scott, M.B., dated April 1, 1915.
Cresswell Burrows, M.D., dated April 1, 1915.
Maurice U. Wilson, dated April 1, 1915.
Humphry J. Wheeler, M.D., dated April 1, 1915.
John Wotherspoon, M.B., dated April 1, 1915.
George F. White, M.D., dated April 1, 1915.
Hyman Lightstone, dated April 1, 1915.
John J. Scanlan, dated April 1, 1915.
Alfred H. Bell, dated April 1, 1915.
Frank H. White, dated April 1, 1915.
Hugh H. Robinson, dated April 1, 1915.
Thomas W. S. Hills, dated April 1, 1915.
Eric L. Giblin, M.B., dated April 1, 1915.
Percy W. Kent, dated April 1, 1915.
Edgar Babst, M.B., dated April 1, 1915.
Arthur L. M. Churchill, dated June 17, 1915.
Leslie M. Ladell, M.B., dated May 27, 1915.
Daniel D. Brown, M.D., dated April 19, 1915.
James H. Chauncy, dated June 21, 1915.
George MacL. Levack, M.B., dated April 19, 1915.
Herbert Edward Murray, M.B., dated April 20, 1915.
Lionel G. Pearson, M.B., dated April 28, 1915.
Harry G. Butterfield, M.D., dated May 4, 1915.
Arthur S. Walker, M.D., dated May 13, 1915.
Herbert Robertson, M.B., dated May 15, 1915.
Thomas L. de Courcy, M.D., dated May 17, 1915.
George Eustace, M.D., dated May 18, 1915.
John H. Jordan, dated June 9, 1915.
Joseph P. Fagan, dated June 11, 1915.
Thomas Aspinall to be Lieutenant, dated July 12, 1915.
Frederick G. Vicars, dated July 15, 1915.
Alexander F. Wilson, M.B., dated July 21, 1915.
Kenneth J. T. Keer, dated July 23, 1915.
Ivan W. McKimmon, M.D., dated July 20, 1915.
Meredith Broderick Dawson to be Lieutenant, dated September 18, 1915.
Captain David A. Hughes to be Major, dated July 18, 1915.
Captain George F. Morley to resign his commission on account of ill-health.
Lieutenant William J. Lacy-Hickey, M.B., to be Captain, dated August 19, 1915.
Andrew MacLennan, M.B. (late Surgeon-Captain, 2nd Volunteer Battalion, the Cheshire Regiment), to be Captain, dated August 20, 1915.
Captain Harold B. Porteous, M.B., from 2nd South Western Mounted Brigade, Field Ambulance, to be Captain.

SANITARY SERVICE.

Major Charles E. Humphreys to be Lieutenant-Colonel, dated August 8, 1915.
The undermentioned Officers relinquish their commissions, dated September 10, 1915:—
Lieutenant-Colonel Robert S. Gibb, M.B.
Lieutenant-Colonel William G. Stevens.
Major William Bruce, M.D.

Major John C. McVaill, M.D.
Captain Henry W. Beach.
Captain James A. Cameron, M.D.
Captain David Havard.
Captain George F. McCleary, M.D.
Captain Thomas Rogerson, M.B.
Major George Reid, M.D., resigns his commission on account of ill-health, dated September 14, 1915.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1915.

Title of Work and Author	Edition	Date	How obtained
Gunshot Injuries, how they are inflicted, their Complications and Treatment. By Colonel Louis A. Lagarde, Medical Corps, U.S.A.		1915	Library Grant.
The Minor Horrors of War. By A. E. Shipley ..	2nd	1915	,, ,,
Sanitation in War. By Major P. S. Lelean, R.A.M.C.		1915	,, ,,
War Surgery. By E. Delorme. Translated by H. de Meric		1915	,, ,,
Radiography, X-Ray Therapeutics, and Radium Therapy. By Robert Knox, M.D.		1915	,, ,,
The Diagnostics and Treatment of Tropical Diseases. By E. R. Stitt, M.D.		1915	,, ,,
Cambridge Public Health Series: Sewage Purification and Disposal. By G. B. Kershaw		1915	,, ,,
Gas Poisoning in Mining and other Industries. By John Glaister, M.D., and D. L. Logan, M.D		1914	,, ,,
The British Pharmaceutical Codex and Suppplement		1911-15	,, ,,
The Medical Annual		1915	,, ,,
Theoretical Chemistry. By W. Nernst. Revised by H. T. Tizard		1911	,, ,,
Organic Chemistry. 2 vols. By Prof. V. von Richter. Edited by Prof. R. Anschütz. Translated by E. F. Smith		1912	,, ,,
Dairy Chemistry. By H. D. Richmond	2nd	1914	,, ,,
Treatise on General and Industrial Chemistry. By E. Molinari. English Translation. 2 vols.		1912-13	,, ,,
The Treatment of Fractures. By C. L. Scudder, M.D.	5th	1915	,, ,,
Collected Papers of the Mayo Clinic. Edited by Mrs. M. H. Mellish. Vol. vi. 1914		1915	,, ,,
A Text-Book of Physiological Chemistry. By Olof Hammarsten and S. G. Hedin. Translated by John A. Mandel	7th	1914	,, ,,
A Text-Book of Pharmacology and Therapeutics. By Arthur R. Cushny, M.D., F.R.S.	6th	1915	,, ,,
Treatment of Diseases of the Eye. By Dr. V. Hanke. Translated by J. H. Parsons and G. C ats		1905	,, ,,
Surgery of Deformities of the Face. By J. B. Roberts		1912	,, ,,
Surgery and Diseases of the Mouth and Jaws. By V. P. Blair, A.M., M.D.	2nd	1913	,, ,,

List of Books added to the Library—*Continued.*

Title of Work and Author	Edition	Date	How obtained
John Shaw Billings: a Memoir. By Fielding H. Garrison, M.D.		1915	Library Grant.
Tenth and Eleventh Reports of the Henry Phipps Institute for the Study, Treatment, etc., of Tuberculosis		1915	Editor, Journal.
Report on Higher Education in the State of New York for the School Year ending July 31, 1913		1915	,, ,,
Elements of Surgical Diagnosis. By Sir A. Pearce Gould. Revised by E. Pearce Gould	4th	1914	,, ,,
A Text-Book of Radiology. By E. R. Morton, M.D.		1915	,, ,,
Dietetics, or Food in Health and Disease. By W. Tibbles, M.D.		1914	,, ,,
The Acute Abdomen. By W. H. Battle	2nd	1914	,, ,,
Annual Report of the Surgeon-General of the Public Health Service of the United States for the Fiscal Year 1914		1914	,, ,,
The Medical Annual Synoptical Index to Remedies and Diseases. For the ten years 1905 to 1914		1915	,, ,,
Index Catalogue of the Library of the Surgeon-General's Office, United States Army. Second Series. Vol. xix		1914	Surgeon-General, U.S. Army.
Annual Report of the Sanitary Commissioner with the Government of India for 1913			Secretary of State for India in Council.
Proceedings of the National Academy of Sciences. Vol. i. Numbers 1 to 8.		1915	Commandant's Office.
Metropolitan Water Board: Eleventh Report on Research Work. By Dr. A. C. Houston.		1915	Presented by Dr. A. C. Houston.
Report of the Eighty-fourth Meeting of the British Association for the Advancement of Science. Australia, 1914; July 28 to August 31.			Presented by Surgeon-General Sir D. Bruce, C.B., F.R.S.
The Journal of Pathology and Bacteriology. Vol. xx. No. 1. July, 1915		1915	,, ,,
Military Report on the Straits Settlements, 1915 ..		1915	War Office.

DEATH.

MANDERS.—On August 9, 1915, killed in action at the Dardanelles, Colonel Neville Manders, Army Medical Service, aged 55, youngest son of the late Major Thomas Manders, 6th Dragoon Guards (Carabiniers), and the late Mrs. Manders, of Marlborough, Wilts, dear husband of Maude Braybrooke, only child of F. W. Vane (of Ceylon), Glenthorne, Bexhill-on-Sea. "In Arduis Fidelis."

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Notices.

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All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel R. J. Reece, Lieutenant-Colonel P. H. Falkner, Major W. S. Carline, Major G. Baillie, Major M. Sinclair, Captain C. M. Page, Lieutenant J. S. Goodacre, Lieutenant J. Anderson, Lieutenant L. H. C. Birkbeck, Lieutenant G. N. Lorimer, Serjeant-Major E. B. Dewberry, C. Hamilton Whiteford, Lieutenant A. J. Trinca.

The following publications have been received:—

British: The Indian Medical Journal, The Lancet, The Sanitary Record and Municipal Engineering, The Journal of Tropical Medicine and Hygiene, The Medical Press and Circular, The Indian Medical Gazette, The Indian Journal of Medical Research, Guy's Hospital Gazette, Tropical Diseases Bulletin, The Hospital, The Journal of State Medicine, The Practitioner, St. Bartholomew's Hospital Gazette, Bulletin of Entomological Research.

Foreign: Revista de Sanidad Militar, Bulletin de l'Institut Pasteur, Le Caducée, The Military Surgeon, Office International d'Hygiene Publique, Russian Naval Medical Journal.

MANAGER'S NOTICES.

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